Response to RFP No. 65A0151 "Slurry/Micro-Surface Mix Design Procedure" Part I – Technical Proposal

Prepared for

California Department of Transportation
Division of Procurement and Contracts
1727 30th Street
Sacramento, CA 95816

Prepared by

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And

MACTEC
CONSOLIDATED ENG LABS
APTECH

November 13, 2002

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Mr. Dennis Siebert
Department of Transportation, MS-67
Division of Procurement & Contracts
1727 30th Street
Sacramento, CA 95816

RE: RFP 65A0151 "Slurry/Micro-Surface Mix Design Procedure"

Dear Mr. Siebert:

The Fugro-BRE team is pleased to submit this response to RFP 65A0151 for your consideration. We have put together an outstanding team consisting of the following organizations:

- **Fugro-BRE**
- **MACTEC (Formerly LAW Crandall)**
- **Consolidated Engineering Laboratories**
- **APTech (our DBE)**

The combined team members offer the best technologists in slurry/microsurfacing technologies, along with strong laboratory capabilities in emulsions, and a highly qualified team of engineers with extensive experience in slurries and microsurfacing.

We believe we meet all the requirements set forth in the RFP and look forward to the possibility of working with you on this important project.

Very truly yours,

James S. Moulthrop
Project Manager

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Section 1
Management

MANAGEMENT

The project team will be led by Mr. James Moulthrop, Fugro-BRE as Project Manager and supported by Mr. Glynn Holleran, APTech, as Co-Project Manager. The team organization chart is presented in Figure 1.1. The project team includes key personnel from each of the participating team members. Their role in the project is defined in Section 4 – Personnel. In addition, an outstanding group of industry advisors have agreed to participate at no cost to the project as indicated in Section 9, Appendix B.

The project will require staff with broad expertise in materials, test methods, pavement engineering, pavement evaluation and data collection, materials sampling and testing, etc. The project team exceeds the following minimum qualifications established by the RFP:

- Extensive laboratory experience (3-5 years).
- Extensive field experience (3-5 years).
- Broad pavement knowledge and experience, nationwide (at least 10 years).
- Experience in binder and emulsion research (3-5 years).
- Experience in test method development (develop at least 2 test methods).
- Knowledge in pavement evaluation techniques (involved in at least 5 pavement evaluations).
- Experience in coursework development and training (developed at least 5 training modules).

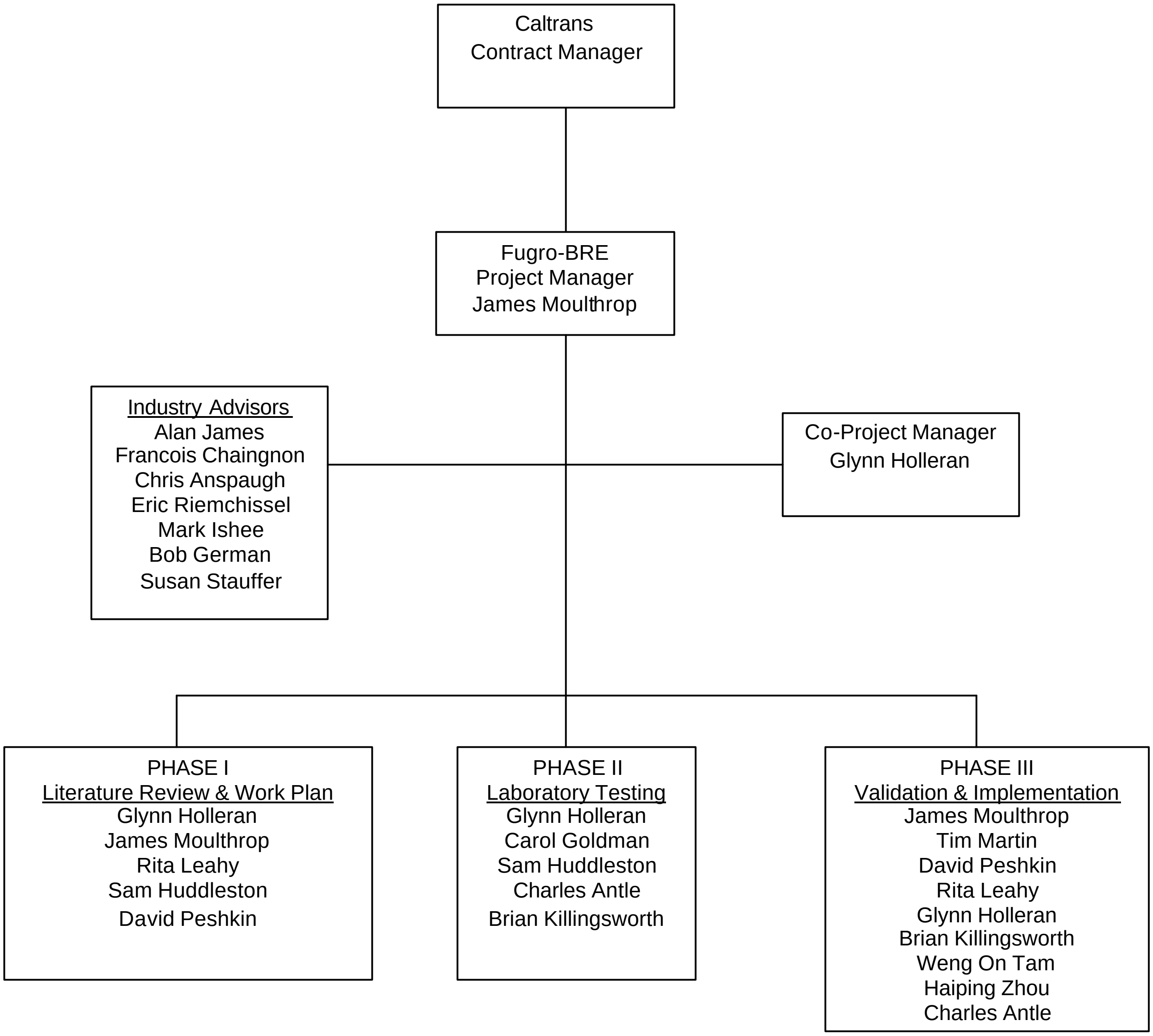

Figure 1.1 FUGRO-BRE Team Organization

Section 2
Methodology

RESEARCH PROBLEM STATEMENT

There is a need to develop new mix design procedures, guidelines, and specifications for slurry seal and micro-surfacing that address performance needs of the owners and users, the design and application needs of the suppliers, and improve the reproducibility of the designs. The current ISSA procedures for Slurry Seal Mix Design (A105) and Micro-surfacing (A143); Practices for Design, Testing and Construction of Slurry Seal (ASTM D3910-98), and Practice for Design, Testing and Construction of Micro-surfacing (ASTM D6372-99) have their origins in the 1980's before the wide-spread use of micro-surfacing and the use of polymer modified emulsions in slurry seals. These test methods and design procedures are used because there is no test method or mix design procedure that specifically addresses micro-surfacing and the adequate representation/characterization of its performance indicators. Recent Texas Transportation Institute studies documented the problems associated with using the existing methods of micro-surfacing and suggested the development of comprehensive mix design and analysis procedures. While differences exist between slurry seal and micro-surfacing applications (i.e., traffic volume, application thickness, and curing mechanisms), the similarities of the tests currently used indicated that the two systems must be studied together.

GOAL

The overall goal of this project is to improve the performance of slurry and micro-surfacing surface treatments through the development of a rational mix design procedure, guidelines and specifications.

OBJECTIVES

1. Develop mix design procedures.

    - Identify the critical properties of the mix and the raw materials that relate to performance and ensure material compatibility of the different components.
    - Identify/develop tests that will evaluate the raw materials and mix for the critical properties described above.
    - Identify/develop tests to evaluate if the mixture can be properly mixed and placed.
    - Identify/develop tests to evaluate the setting and curing characteristics of the mix.
    - Develop an initial mix design that incorporates these properties and tests, and addresses various environmental and surface conditions.

2. Develop guidelines and specifications for use and application.

   - Ensure proper mixing, wetting, and adhesion in the field.
   - Ensure that the mixture does not segregate during field application.
   - Ensure a homogenous spreading of the treatment over the pavement surface.
   - Provide guidance on the emulsion curing characteristics that take into account different surfaces, traffic volumes, and environmental conditions.
   - Provide guidance in the appropriate use of this treatment that includes, as a minimum, pavement and environmental conditions, traffic characteristics (including ADT ranges), and road geometry (e.g., grades, intersections, etc.).
   - Identify the characteristics that ensure long-term performance.
   - Provide guidance on project selection.
   - Provide recommended specifications for use on projects.

3. Develop a training program.

   - Develop a training workshop that incorporates all aspects of slurry/micro-surfacing for a wide range of target audience including transportation agencies, contractors, and suppliers.
   - Develop a pre-job training module for inspectors and contractor's staff.

GENERAL APPROACH

The goal of this study, as noted above, is to improve the performance of slurry surfacing and microsurfacing by developing a rational mix design procedure. To reach this goal, it will be necessary to accomplish the following:

- Determine, from a literature review, contacts with international contractors and suppliers; and, upon the advice of our industry advisors, the factors that most affect the performance of these products.

- Examining the current test methods and procedures used in the design of these mixes, we will determine which methods should be discontinued and those that can still be used with or without some modification.

- Where necessary, develop new methods and procedures that address issues of constructability and that relate to performance.

- Perform a ruggedness evaluation on those methods deemed suitable for mix design purposes.

- When the above items are accomplished, develop guidelines for the use of these products as well as specifications.

- A training package will be developed that incorporates the result of the study and will include a guide to the selection of candidate projects, specifications for use, guidelines for agencies and contractors, and a pre-construction module that can be used to identify proper construction procedures.

- Aid in the planning and construction of pilot projects throughout the United States (U.S.) to validate the design procedure.

SPECIFIC TECHNIQUES

During the course of the project the plan is to use the expertise of the advisory panel, who represent a broad segment of the slurry surfacing and microsurfacing industry, both nationally and internationally. For example, the team is aware of different test methods and procedures that are used in the design of these mixes in other countries. These will be explored and evaluated for application in the U.S. Other specific techniques are:

- Use of the extensive database retrieval capabilities of the project team.

- Explore the use of test methods in other industries, i.e., composites, adhesives, coatings, etc., that might have application.

- Use the expertise in test method development and procedures within the laboratories of team members Mactec and Consolidated.

- Utilize the capabilities of Dr. Charles Antle in the development of an experimental plan to accomplish the ruggedness testing of new equipment and methods and an experimental plan to evaluate the performance of pilot sections constructed across the U.S.

- Use FHWA certified distress raters and a suitable distress identification manual to evaluate the pilot projects.

ADMINISTRATIVE AND OPERATIONAL MANAGEMENT

The management of this project for both administrative and operational purposes will be the responsibility of Fugro-BRE. Mr. James Moulthrop will be the Project Manager and will head the project team. He will be supported in this effort by Mr.Glynn Holleran (Co-Project Manager) and the other excellent team members previously noted in Figure 1.1. Fugro-BRE has a very proficient administrative staff in Austin, Texas, with experience in handling the administrative functions for a major research project.

Section 3
Work Plan & Schedule

WORK PLAN AND SCHEDULE

This section presents the detailed work plan for each of the three phases outlined in the RFP. Each phase is further sub-divided into specific tasks. Table 3.1 summarizes the various tasks associated with the proposed study and Figure 3.1 shows the timeline for completing each of the phases and tasks.

PHASE I- CONDUCT A LITERATURE SEARCH AND DEVELOP WORK PLANS

Phase I has 2 major components – one a literature review and the other the development of a detailed work plan for Phases II and III. This phase is expected to be completed within four months after initiation of the contract.

TASK 1.0: LITERATURE AND INDUSTRY SURVEY

The purpose of this task is to collect background information about all facets of slurry surfacing and microsurfacing projects both in the United States and worldwide. This will be accomplished through both a literature search and surveys of, and interviews with, knowledgeable individuals and organizations. This is described in greater detail in the following paragraphs:

Literature Review: A literature review will be performed to determine the current state-of-the-practice and status of existing research. This will include a bibliographic database search (TRIS and others) and a review of all current literature on slurry surfacing and microsurfacing mix design. The investigators are familiar with most of the literature, both in the United States and abroad and have significant personal libraries on the subjects

Contacts with Industry Organizations: There are a number of industry organizations around the world that provide technical support for slurry and microsurfacing materials and projects, including the International Slurry Surfacing Association (ISSA), the American Society for Testing and Materials (ASTM), the Asphalt Emulsion Manufacturers Association (AEMA), the Australian Asphalt Pavement Association (AAPA), South African Bitumen Association) (SABITA), the U.K Slurry Association, and the French Society For Bitumen Emulsions (SFERB). The project team is very familiar with the products as well as the administrative and committee structures of these organizations and will easily be able to establish successful contacts with their appropriate representatives. Inquiries will be made to access publications and literature produced in committees and published conference proceedings that will be included in the literature review of historical mix design research. Established contacts would be used to examine best practices and design in USA, Germany, France, Asia, Australia, New Zealand, United Kingdom (U.K.) China, and Russia. The use of these international contacts will be done on an ad hoc basis (where their specific knowledge and expertise can best be used) and we will use e-mail as the primary vehicle of communication.

Table 3.1 Slurry Seal/Micro-Surfacing Mix Design Project Tasks

CALTRANS SLURRY / MICROSURFACING MIX DESIGN PROJECT
CALTRANS RFP # 65A0151

RESPONSIBLE ORGANIZATIONS	PRINCIPAL
Fugro-BRE	**Jim Moulthrop**
Mactec	**Gary Hicks**
Consolidated Labs	**Carol Goldman**
APTech	**Steve Seeds / Glynn Holleran**

PROJECT TASKS

Phase I	**Literature Search and Work Plan Development**
Task 1	Conduct literature search and survey. Include State DOTs, local, international, industry.
1.1	Current mix design procedures.
1.2	Lab tests and material physical properties.
1.3	Critical factors relating to performance
1.4	Performance of existing projects.
1.5	Existing guidelines and specifications.
1.6	Extent of use worldwide.
1.7	Failure modes.
1.8	Benefits and limitations.
1.9	Intended use and expectations.
1.10	Constructability issues.
1.11	Thickness, age, traffic, surface conditions , climate and history.
Task 2	Phase I Report: Work Plans for Phases II and III
Phase II	**Develop Mix Design Procedures** [Based on Performance and Constructability Parameters]
Task 1	Evaluate potential test methods [old/new].
1.1	Critical physical properties that indicate performance.
1.2	Recommend mix design procedures.
Task 2	Evaluate successful constructability indicators.
2.1	Revise mix design as required.
2.2	Develop field tests and methods to adjust for various environmental and surface conditions.
2.3	Construction methods and equipment.
Task 3	Conduct ruggedness testing of recommended equipment and procedures.
Task 4	Phase II Report
Phase III	**Develop Guidelines and Specifications**
Task 1	Develop Guidelines and Specifications.
Task 2	Develop a training program for a workshop containing a pre-construction module.
2.1	Manual
2.2	Training material
Task 3	Construct pilot projects for validation of procedures in States: CA, GA, IL, KS, MI, MN, ND, NE, NH, NY, VT.
3.1	Identify State DOT's interested in sponsoring pilot projects.
3.2	Identify candidate test sites representing various climate and traffic conditions.
3.3	Develop performance evaluation plan.
3.4	Revise procedures based on test section performance.
3.5	Revise training program as necessary.
Task 4	Final Report

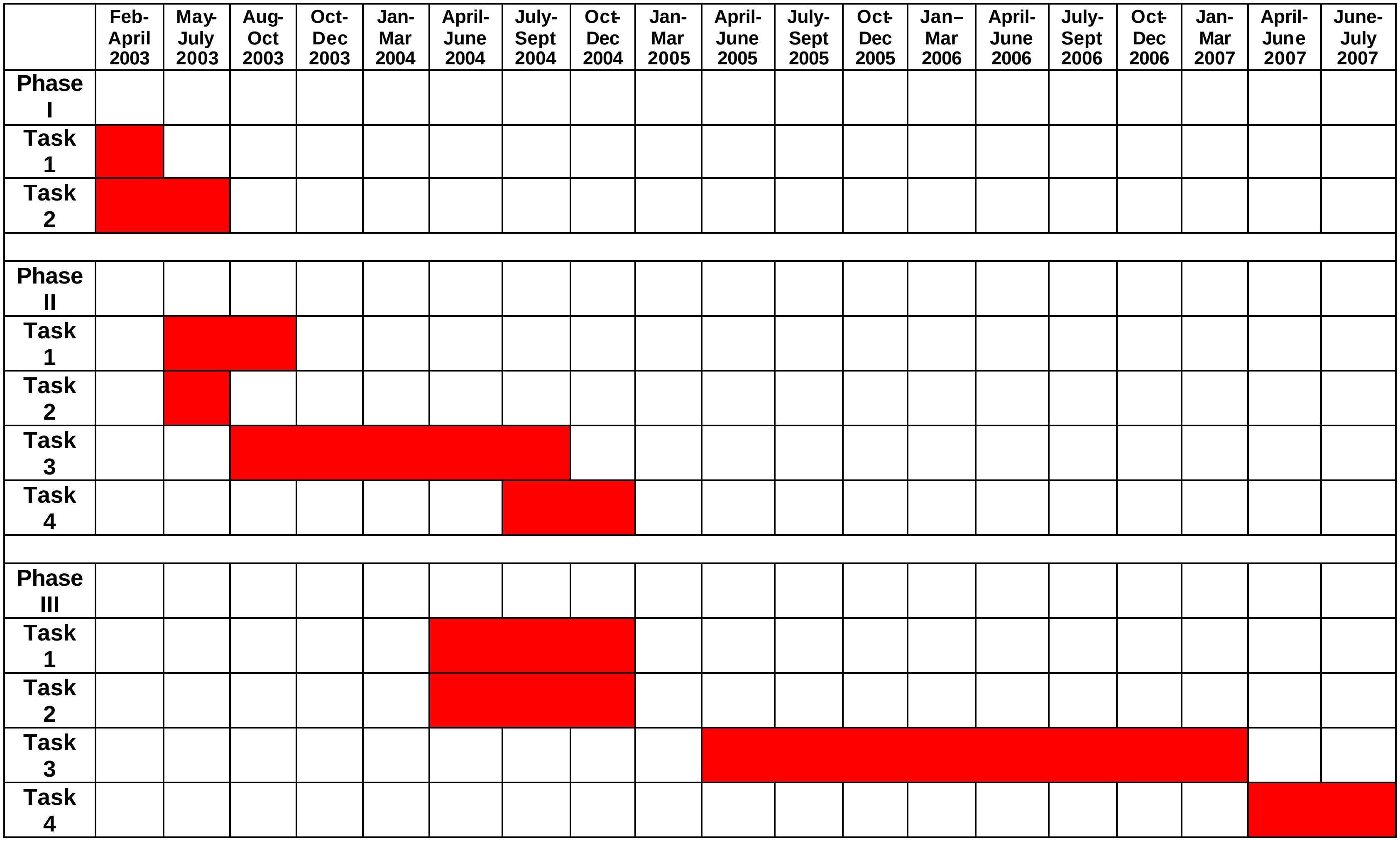

Figure 3.1 Slurry seal/micro-surfacing mix design time requirements.

Survey of Known Slurry Surfacing and Microsurfacing Users: A survey will be made of public agencies, contractors, emulsion manufacturers, chemical manufacturers (who are involved in the design of mixtures as a means of marketing chemicals) and others in the US and international slurry surfacing and microsurfacing industry. The survey will solicit responses on the use of current mix design procedures and tests, determine the satisfaction with each method and procedure, and identify those methods and procedures that need improvement, or elimination, and explore new developments. Typical questions might include the following:

- In designing slurry surfacing and microsurfacing mixes, do you use the current ISSA design procedures?
- If "No," what processes do you use?
- If "Yes," are there any parts of the procedure you don't use or have modified?
- Are any of the test methods and procedures in need of revision or elimination?
- Do the procedures relate to performance in the field?

Expected Outcomes Of the Literature Search and Survey: The goal of the literature search and the survey is to identify the critical success factors that relate to the performance of slurry surfacing and microsurfacing and document the best practices used by contractors, suppliers, and users. How various agencies take into consideration existing pavement deterioration, climatic conditions, and seasonal constraints in the use of slurry surfacing and microsurfacing will also be studied from user experience. The requirements of raw materials will be included with respect to the climate and performance criteria. The use of test equipment developed in the SHRP program for characterizing component material (e.g. dynamic shear rheometer, bending beam rheometer, pressure aging vessel, and so on) and specifications will be considered to replace the procedures currently in use.

The following specific subtasks are outlined in the RFP and the results from the Literature Search and Survey will be evaluated and organized by these subtasks.

Task 1.1 Current Mix Design Procedures

The ISSA has long used a set of technical bulletins for mix design [1]. However, the tests described in those bulletins are empirically based and represent a limited range of materials and conditions. Furthermore, they make no allowance for traffic and are not performance based. In many countries and States, mix designers have adopted procedures to adjust the mix design based on experience in specific areas. This survey will identify the current mix design that is being used and what it attempts to measure. The survey will also collect information on any other tests that are used and what properties they measure, or purport to measure, and provide a basis for an analysis of the potential use of these tests in the new mix design framework.

Task 1.2 Laboratory Tests

The existing laboratory tests for slurry surfacing and microsurfacing materials will be examined in the light of what properties are measured and why they are measured. Also, it is known that some agencies modify these properties and specifications for different climatic conditions and performance requirements and information on those modifications will be collected and assessed. Tests should evaluate the interaction between the mixture components, the aging characteristics of the mixture, and the mixture's permeability. Another important consideration is the ease of use and the cost of the various tests.

Task 1.3 Critical Factors that Relate to Performance

Critical performance factors are those engineering properties that are known to affect performance. The critical performance factors identified in the survey will be examined with respect to the engineering properties of the materials and the mixtures. It is important to determine how field variables affect the performance of the mixture. The primary variable of interest is the effect that environmental conditions, both during application as well as in service, have on the performance of the treatment. The project team will also examine how other factors such as traffic, underlying pavement conditions, snow plow use, chains and studded tires, and freeze-thaw cycling affect the desired properties. Aging resistance and water permeability of compacted and un-compacted mixtures are likely to be critical so they will be also be evaluated.

The failure modes that slurry surfacing and microsurfacing typically are used to correct will be considered in relation to their final properties. The critical factors (such as rutting, raveling, minor cracking, loss of surface texture, and so on) fall naturally into four areas of interest with respect to design. These are: properties of the materials as they are being mixed; properties of the resultant mixtures as they are spread; break and cure of the mixtures (traffic time); and properties of the final cured mixture with respect to performance (such as raveling, deformation, cracking resistance and life expectancy). Test methods will be grouped within each of these areas and then ranked according to the following criteria:

- **Ease of use** – Slurry surfacing and microsurfacing mix design procedures must be easy to use (whether the user is in the public or private sector). If the procedures are not easy to use then the material will not be used as often as it should be.

- **Ability to predict a performance parameter** – Each method in the design procedure must, on its own or when integrated with other methods, reliably predict one or more measures of performance.

- **Cost** – The end product of the research should identify design procedures that are <u>affordable</u> for suppliers, contractors, and agencies. Low costs will permit easy access to the equipment and help to ensure that reliable design and testing practices are followed.

- **Ruggedness** – The mix design procedure must be capable of meeting the ASTM requirements for ruggedness. Ruggedness is defined as the insensitivity of a test method to departures from specified test or environmental conditions.

The above criteria will be used to analyze the strengths and weaknesses of current practices and identify candidate tests to measure the performance parameters of interest.

Areas where suitable test methods do not exist will be highlighted and an examination of methods used in other industries where similar parameters are important will be accomplished. For example there may be procedures in the adhesives or composites industry to characterize workability and coating properties of materials that can be readily adopted for the slurry surfacing and microsurfacing industry. Obviously, cost will be a factor in deciding whether or not to use other procedures.

Task 1.4 Performance of Existing Projects

In order to improve existing practice, it is important to understand how the currently used technologies have worked. Candidate sources of information will be identified from the survey results and interviews. While the emphasis will be to collect data on successful projects, it is important that both good and bad projects be identified and categorized according to their performance properties. Known sources of information include a California microsurfacing pilot study as well as the experiences of other states, cities and counties, and countries. For any project that is evaluated in this effort, required information includes performance characteristics divided into the three key areas of mixing, curing, and service performance. Thickness, age, traffic, surface conditions, climate, and rehabilitation history will all be considered in evaluating performance.

Task 1.5 Existing Guidelines and Specifications

A number of agencies that use slurry seals and microsurfacings have modified available specifications to address local conditions. In this subtask, available specifications from both the United States and overseas will be collected and analyzed. The analysis will consider the specifications and performance parameters, and how they affect field performance in the projects as noted above. Guidelines will also be collected to assist with this analysis and to determine the important features that are necessary to relate to contractor and agency personnel to assure an acceptable project.

Task 1.6 Extent Of Use Worldwide

This will be surveyed and the results will be analyzed with respect to climatic condition, types of roads, traffic, and materials used. This will establish any generalized success requirements (e.g. Saudi Arabia uses the product only on secondary roads since it addresses the needs in hot, dry climates).

Task 1.7 Failure Modes

There are two failure modes of interest: the failure modes in existing pavements that slurry seals and microsurfacings are meant to address and the failure modes of the slurry and microsurfacing treatments themselves.

Failure modes in slurry surfacing and microsurfacing include raveling, cracking, delamination, aging, wear, stripping, and deformation. Failure modes that are addressed by slurry surfacing and microsurfacing include loss of skid resistance, raveling, and rutting (microsurfacing).

The research team will explore the relationships between testing methods and specifications on the one hand, and the two types of failure modes on the other. Quantifying the relationship with pavement failures will lead to better guidelines for project selection, while quantifying the relationship with treatment failures should help to modify the tests and specifications themselves. Relating these failure modes to performance will allow the performance parameters to be directly related to the intended use of the products and the expectations of the customers.

Claims will be assessed with respect to the performance parameters chosen above and the project information available. This will further indicate the important properties of the materials in terms of the failure modes.

Task 1.8 Benefits and Limitations

This will be included in the survey in order to determine those features of slurry surfacing and microsurfacing that users consider beneficial to the pavements where these techniques are being placed. Benefits can include both monetary and functional ones. In addition, it will be necessary to determine user-defined limitations (traffic volumes, pavement conditions, functional classification, and so on) in order to provide these in the guidelines that will be developed in Phase III.

Task 1.9 Intended Use and Expectations

The survey will indicate why respondents have used, ceased to use, or never used slurry surfacing or microsurfacing. This is a method of obtaining the “voice of the customer.” This will allow the conversion of these needs and expectations into technical performance parameters, then into technical goals and measurable variables that may be optimized in a new mix design procedure. Key areas will be the time required for the mixtures to break and cure under the range of conditions encountered, surface finish and service properties in terms of skid resistance, resistance to raveling, cracking, and deformation.

Task 1.10 Constructability

Issues of constructability are key to achieving the intent of the mix design. Workmanship issues are important and this item directly relates to the mixing and curing features of the mixture, or its workability. Equipment and training are also important. The survey will clearly define the main factors that determine the constructability of slurry surfacing and microsurfacing projects. This will be related to the thickness of application, the existing surface conditions, and climate and the required time to trafficability.

Issues such as the requirements for rolling mixtures, special spreading box requirements, handwork, and other workability issues will also be analyzed.

The ability of the mix design to allow for constructability issues is not currently addressed and can lead to poor surface texture and segregation. The materials and mixture variables that may influence the final work will be addressed with respect to the design criteria and their physical properties.

Task 1.11 Thickness, Age, Traffic, Surface Conditions, Climate, and History

Each of these items will affect the performance characteristics of slurry surfacing and microsurfacing mixes and will be noted and analyzed as to how critical each one relates to performance in the survey that we will undertake in this task.

TASK 2.0 DEVELOPMENT OF WORK PLAN FOR PHASE II AND III

It is expected that the literature review will provide the following:

- Identification of raw material interactions that will affect performance at any stage of the process.
- Identification of the performance parameters for the mixing, curing, and spreading of the mixtures.
- Identification of the in-service performance parameters for the cured mixture.
- Analysis of existing design methods and their weaknesses and strengths, to highlight where modifications or new tests will be required.
- A list of potential test methods ranked in order of compliance with the criteria of effectiveness, cost, and ease of use.
- An analysis of practices, guidelines, and specifications from around the world, which will be used to create a summary of what is current best practice.
- Proposed framework for a new mix design based on performance parameters and taking into account constructability and in-service performance.

Task 2.1 Develop Work Plans for Phases II and III

Using the information collected and analyzed during the Literature Review and other surveys, coupled with the expertise of the project team, work plans for the development of mix design procedures based on performance and constructability and recommendations for pilot projects and implementation will be developed in this task.

In developing the work plan for Phase II, we will consider and evaluate the current ISSA mix design procedures and any modifications suggested to these methods that come out of the Phase I effort as a first step. For reference purposes, a flow chart of the current design steps is provided in Figure 3.2.

In developing this proposal, the project team has developed a "straw man" flowchart that contains one approach for a revised mix design process that considers workability, constructability, and performance. This flowchart is noted in Figure 3.3.

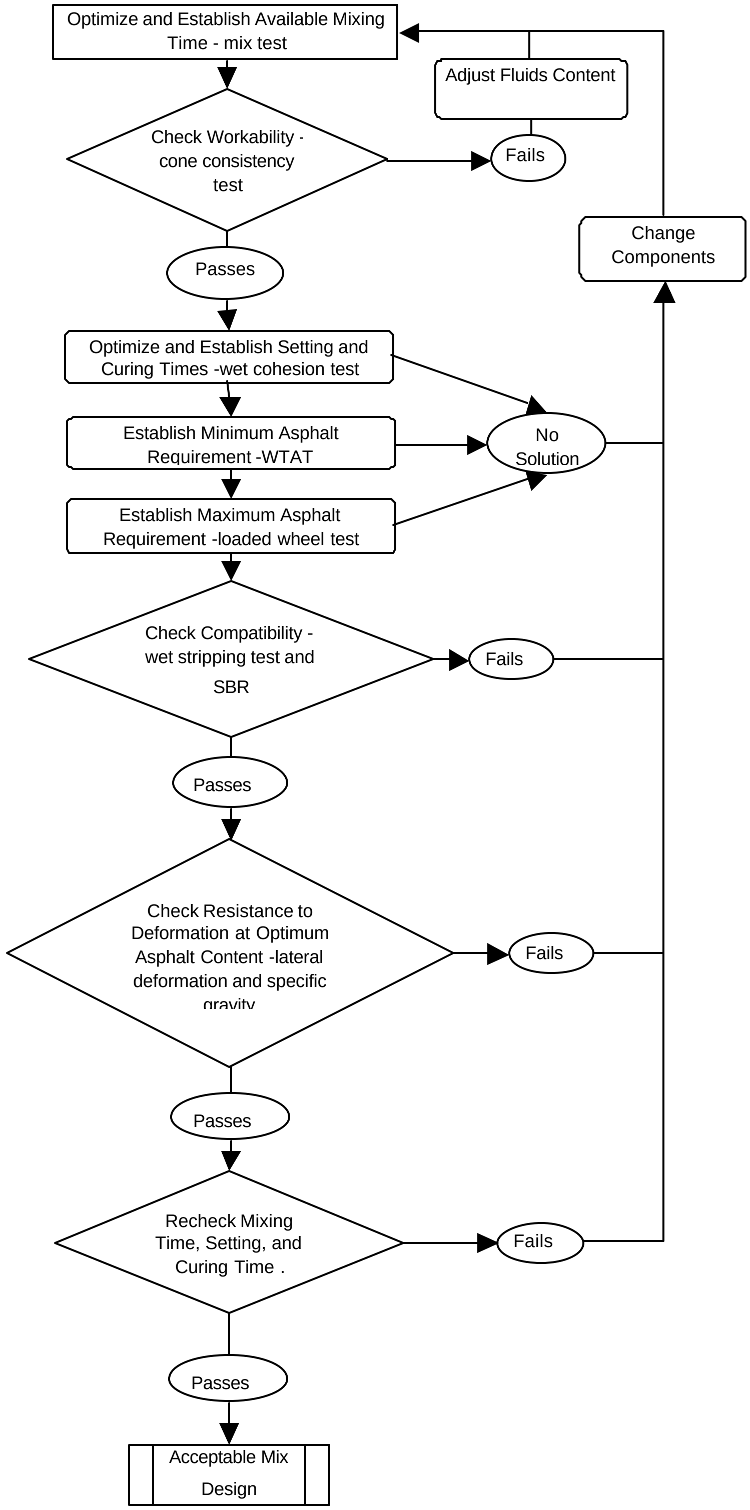

Figure 3.2 Current slurry surfacing/micro-surfacing mix design.

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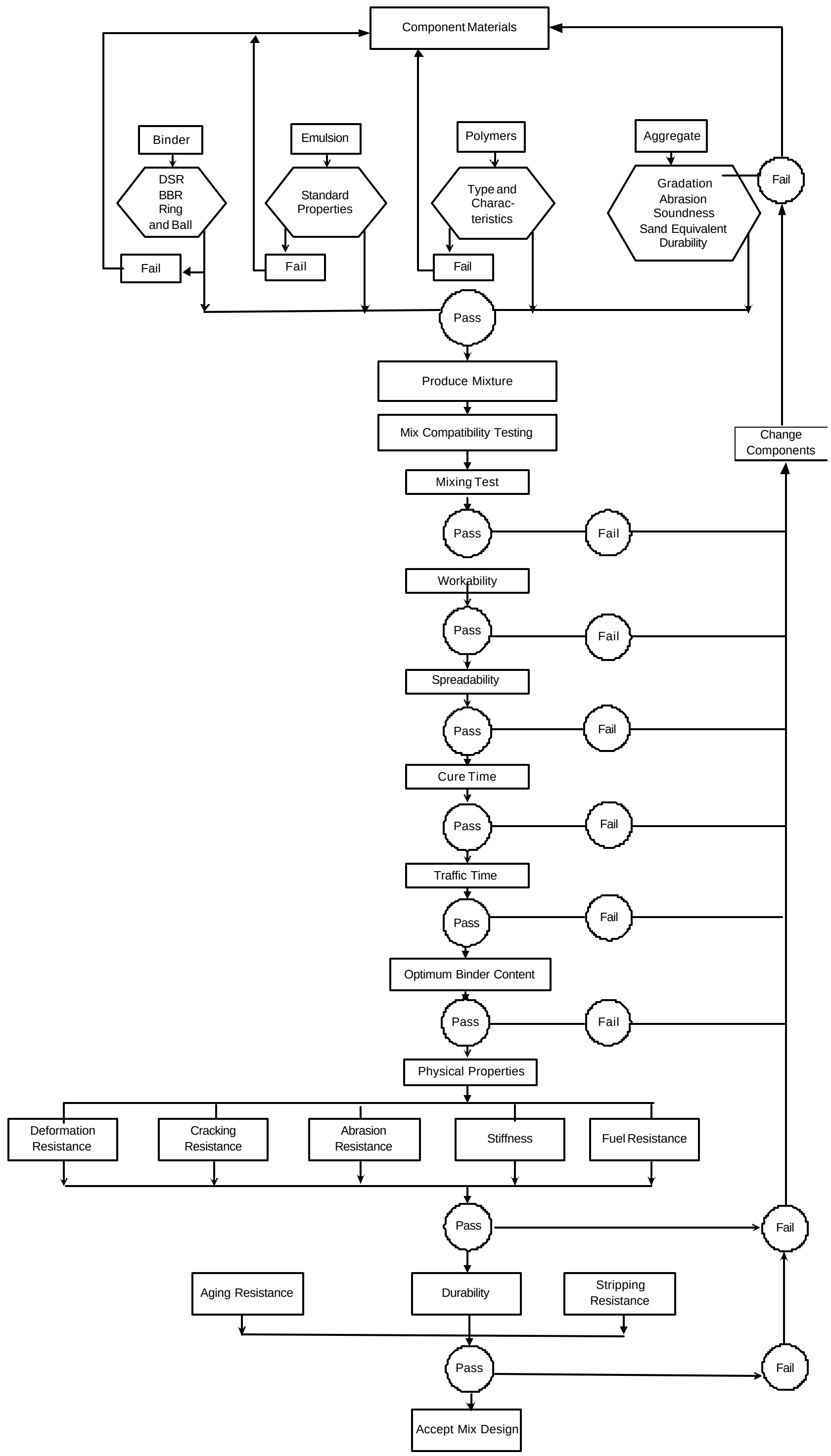

Figure 3.3 Proposed slurry surfacing/micro-surfacing mix design framework.

Although Figure 3.3 is only conceptual at this time, it may provide the basis of for the work in Phase II. During this phase, the project team will evaluate existing and potential new test methods; evaluate successful constructability indicators; conduct ruggedness tests on recommended equipment and procedures; and prepare a report that summarizes all the activities undertaken during the task.

Slurry and microsurfacing are cold mixed asphalt systems that are placed in thin layers. What differentiates them from other cold mix systems is that they are relatively high in binder content and relatively fine in terms of aggregate grading. They are also applied in a travel mixer and rely on the asphalt emulsion coating the aggregate in a controlled way that allows mixing to create a homogeneous and spreadable system. This mixture must not segregate or break prematurely. Once spread, the emulsion must complete its break and adhere to the aggregate to perform properly. This must be done so that the asphalt wets and adheres to the aggregate surface to form a continuous film. The mix must then cure (i.e., build up cohesion to create a three-dimensional matrix of aggregate and binder). All of the components are separate and their interaction is critical.

Positive or deleterious effects of additives need to be quantified within the context of the final material properties and the stages of the design. Current mix design methods attempt to take this inter-relationship into account. However, current approaches are empirical and do not begin to cover all of the possible interrelationships. For this reason, the mixing and workability tests need only relate to machine and spreading parameters and will likely require no significant additional work. Control of these parameters is largely a chemical function and is reliant on the asphalt, emulsifier systems, aggregate and the machinery used. Current tests may be satisfactory for evaluating the mixing characteristics if they are performed under conditions similar to those expected in the field. Instrumentation to determine a limiting mix stiffness and correlation with existing equipment may be all that is required.

Attention to the performance variables of cure rate; strength in early life; resistance to initial, intermediate, and long term traffic; cracking, and climatic conditions are likely to yield the most improvement in field performance.

In Phase III the project team will develop guidelines and specifications; a training program for a workshop that will contain a specific module that can be used for pre-construction training; provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines; and prepare a final report documenting all the activities of the study.

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PHASE II DEVELOP MIX DESIGN PROCEDURES BASED ON PERFORMANCE AND CONSTRUCABILITY PARAMETERS

This phase is divided into 4 main tasks. The estimated time to complete these tasks is given in Figure 3.1

TASK 1.0 EVALUATE POTENTIAL TEST METHODS

The purpose of this task is to evaluate existing and new methods for use in the proposed mix design procedure. The steps to be followed in accomplishing this are described below.

Task 1.1 Critical physical properties that indicate performance

Both existing and new test methods will be evaluated as a part of this task in terms of the following;

- Raw materials. Table 3.1 summarizes the types of tests that will be considered in the evaluation of raw materials.
- Short term performance issues. Table 3.2 summarizes the tests to be considered to evaluate critical short term performance issues
- Long-term performance. Table 3.3 summarizes the tests to be considered for long-term performance.

The criteria used to evaluate and rank the various tests will include, but not be limited to, the following;

- Ease of use
- Ability to relate to performance
- Cost
- Repeatability
- Ease of implementation by SHA's

It may be necessary to modify existing test methods or develop new tests. If so, they must meet the same criteria for evaluation if they are to be recommended for further study.

Task 1.2 Recommend the mix design process

The current and proposed mix design processes have been previously presented in Figures 3.2 and 3.3. Once the laboratory tests have been evaluated, the following approach will be followed to develop an improved mix design process:

- Determine which tests will provide the necessary information for its intended purpose, i.e., short or long term durability in the lab or field tests.
- Develop a rational flow chart for the mix design process similar to Figure 3.3.
- Develop designs using this procedure with materials of known properties in order to validate the process.

We plan to use the knowledge of the project team and the experience of our advisors to facilitate this process.

Task 2.0 Evaluate successful constructability indicators

In this task, we will evaluate the constructability characteristics of the mixes produced using the new design process. These characteristics are influenced by climate, pavement condition, and traffic and manifest themselves in the ability to mix, spread, and finish the mixes. They are also related to the equipment used to mix and place the materials.

Testing and analysis using the proposed mix design procedure will be performed on a slurry seal emulsion and a micro-surfacing emulsion. The emulsions will be mixed and tested with a reference aggregate known to the project team. This is important because: 1) the research team has had extensive experience with this aggregate with multiple emulsion combinations; 2) the aggregate source produces both Type 2 and Type 3 aggregates; and 3) the aggregate source has a good history of maintaining a consistent gradation throughout the construction season and from one year to the next year.

Validation of the mix design process and constructability characteristics will be accomplished by using a small slurry surfacing/microsurfacing machine to mix and place both types of mixes. Using variations in the shear rates of the pugmill and varying mix composition and residence time in the spreader box will permit the team to evaluate the mixing characteristics, workability, and curing characteristics. Samples of the mixes will also be taken for lab analysis.

Task 2.1 Revise mix design procedure as necessary

Based on a limited test program with the known aggregate and the experienced gained during the mix validation effort, each of the tests used will be evaluated in terms of their ability to simulate field conditions. If some of the tests proposed do not work well, the mix design process will be changed.

We plan to accomplish this sub-task by:

- Evaluating the results of the placement of mixes described in Task 2.0.
- Modifying the test methods and procedures where necessary.
- Develop a recommended mix design procedure.

The final mix design procedure will be drafted in a format suitable for AASHTO or ASTM and for use with the pilot projects.

Task 2.2 Develop field tests and methods to adjust for various environmental and surface conditions

Another key component for successful performance is to have simple field tests that can be used to adjust the mix design for various environmental and surface conditions. The field tests under consideration are noted in Table 3.4. During the placement of the validation section noted in Task 2.0, we will:

- Perform the field tests on both the slurry surfacing and microsurfacing mixtures
- Evaluate the methods on the basis of cost, testing time, and the relationship to performance.
- Determine the most suitable tests to recommend for field-testing.

The field tests to be selected will be written in an AASHTO or ASTM format for use with the pilot projects.

Task 2.3 Construction Methods and Equipment

As a part of this effort, it may be necessary to recommend changes to existing construction methods and equipment to improve constructability and short-term performance. Using the information gathered in Task 2.0, we will evaluate changes to the equipment and some of these changes could include the following;

- Recommendations for more or less dwell time in the pugmill.
- Recommendations for reconfiguration of the spreader box to be more mixture "friendly".
- The use of a secondary strike-off for finishing the mixture.

This will be evaluated in limited trails as discussed earlier. The final product from this task will be recommendations for changes to equipment and methods to insure a quality product.

Table 3.1 Raw Materials Characteristics

Component Materials	Current/New Methods	Defined Property
Emulsion & Binder		To collect data from conventional design test methods and new SHRP methods in order to measure properties of thermal susceptibility
Residue Recovery: Distillation Evaporation Forced Fan Evaporation	AASHTO T59 ASTM D244 CT 301	Emulsion binder/solids content; Determining the best method of residue recovery which does not destroy polymer characteristics
Penetration	AASHTO T49 ASTM D5	Standard & low temperature parameters; Performed at 15°C, 252°C
Ring & Ball Softening Point	AASHTO T53 ASTM D 36	Index of residue flow at temperature
DSR	AASHTO TP 5	Stiffness parameters G*/sin d
BBR	AASHTO TP 1	Low Temperature stiffness
DTT	AASHTO TP 3	Low Temperature stiffness
Sliding Plate Viscosity	Australian Standard AS 4311	Standard & low temperature parameters; Measuring thin film viscosity characteristics on aged and unaged binders/residues
PAV	AASHTO TP 1	Aging characteristics of binder/residue
Polymers		Identify for specific characteristics of polymers that would better ensure desired residue properties
Elastic Recovery	AASHTO 301	Ability to measure the amount of polymer in the binder
Torsional recovery	CT 332	Ability to recover from a torsional load, a measure of elasticity
Aggregates: Sieve Analysis	AASHTO T27 ASTM C136 CT 202	Add requirements on fines grading less than 75um; Further evaluate aggregate size proportions
LA Abrasion	AASHTO T96 ASTM C131 CT 211	Aggregate abrasion resistance
Sulfate Soundness	AASHTO T104 ASTM C88 CT 214	Aggregate freeze-thaw resistance
Sand Equivalent	AASHTO T176 ASTM D2419 CT 217	Aggregate fines quality (amount of clay)
Durability	AASHTO T 210 ASTM D 3744 CT 229	Quality of aggregate in a wet condition

Table 3.2 Short Term System Performance Tests

Combined Materials	Current/New Methods	Defined Property
Mixing Time	ISSA TB 113	Available fluid mixing time of all components; Varying temperatures: 10°C, 25°C, 50°C
Mixability Tests	European Cohesion Test	Initial slope of torque curve v. time; Instrumented mixing test with defined mixability index
Workability Tests	European Cohesion Test New: Torque Viscosity	Slope of torque curve v. time after initial mixing; Relates to construction parameters; Increase flow resistance; Varying temperatures: 10°C, 25°C, 50°C
Consistency	ISSA TB 106	Ability of fluid material to flow properly in an un-augered application box; Consistency of mixture in the spreader box stage; Motorized cohesion test or simple cup flow test; Varying temperatures: 10°C, 25°C, 50°C
Spreadability Test	New: Torque Viscosity	Slope of torque curve v. time defined as exiting from mixing box (shear modulus)
Curing Time	ISSA TB 139	Identification of curing time for earliest traffic ability; Varying temperatures: 10°C, 25°C, 50°C
	HILT Bend Test French Test	Identify internal cohesion at traffic time; Varying temperatures: 10°C, 25°C, 50°C
	European Cohesion Test	Identify the build up in cohesion over time; Varying temperatures: 10°C, 25°C, 50°C
Trafficability Test	Oven-cured specimens	Relate cure time test by comparison of oven-cured specimens
	New	Compactability test to determine how long it will take for mix to reach final in-place voids
	New	Permeability of specimens for determining compactability
Additive Effectiveness	Above test methods	Determining the effects of different additives and varying quantities; Varying temperatures: 10°C, 25°C, 50°C

Table 3.3 Long Term System Performance Tests

Combined Materials	Current/New Methods	Defined Property
Initial Target Residual Asphalt Content		Film thickness determinations based on surface area and sieve analysis
Coatability	ASTM D244	Coating characteristics
Wet Stripping	ISSA TB 114 ASTM D3625	Boiling water adhesion
Durability/ Aging/ Stripping	ISSA TB 114 ASTM D3625	Testing compacted mix samples after PAV curing; Stripping test by boiling of aged and unaged specimens
Stripping Resistance	AASHTO T283	Moisture sensitivity of compacted specimens
Wet Track Abrasion	ISSA TB 100 Modified with French Wheel Method	Minimum asphalt requirements under wet abrasive conditions; One hour soak; Varying soaking conditions of time and temperature
Abrasion Test for cured specimens	ISSA TB 100 Modified with French Wheel Method	Effect of wear on pavement surface over the life. Aging indication on PAV-based or oven-based specimens
Water Sensitivity under wheel load	Modified Hamburg Test	Deformation resistance and water resistance utilizing various testing conditions on the Hamburg test equipment
Water Sensitivity Test	ISSA TB 100	Minimum asphalt requirement under wet abrasion conditions; Six day soak; Varying soaking conditions of time and temperature
Volumetric Criteria	Voids determination before and after compaction New method	Optimize asphalt content based on volumetrics; Determine voids-in-place requirements which would give a mechanical set of properties at allowable residual binder levels
Permeability	NCAT procedure	Determine voids permeability at varying asphalt contents
Excess Asphalt	ISSA TB 109	Maximum asphalt content requirement by measurement of hot sand
Crack Resistance Fatigue Testing	Bruge Bending Test-Modified Reflection Cracking JIG Fatigue Thin Slice	Cracking resistance using fatigue testing or flexural testing
Fuel Resistance	ASTM D	Fuel resistance determinations; Varying residual asphalt contents
Pick up	Modified Hamburg Test	Determining optimum asphalt content which would give acceptable pick up per Hamburg test at varying laboratory environmental conditions
Modulus Loss	Indirect Tensile Test	Modulus test on briquette using an Indirect Tensile test
Lateral Displacement	ISSA TB 147	Measurement of lateral deformation under Loaded Wheel Tester
Deformation Resistance	ISSA TB 147 Hamburg/Creep/Modulus	Deformation of multi-layered system

Table 3.5 Field Performance Tests

Combined Materials	**Current/New Methods**	**Defined Property**
Traffic Time/ Cohesion	Ball Penetrometer (Australia)	Measure when the mat can take traffic or can be rolled
Cured Surface Texture	Sand Patch Test ASTM E965	Measure surface texture achieved; Ensure joints are acceptable
Stone Loss Test	Sand Patch Test ASTM E965	To indicate surface texture changes caused by stone loss
Extraction	ASTM D2172	Determining residual asphalt content
Gradation	AASHTO T 27 ASTM C 136 CAL 202	Determining sieve analysis of extracted aggregate
Gradation	AASHTO T27 ASTM C136 CAL 202	Determining aggregate stockpile tolerances
Permeability	NCAT procedure	Permeability of specimens for determining compactability
Project Aesthetics	Codified Visual Assessment	Requirements on joints, handwork, bleeding, stone loss, raveling, ridging, etc. in order to accept the product

TASK 3.0 CONDUCT RUGGEDNESS TESTING OF RECOMMENDED TESTS AND PROCEDURES

The modified existing and new test methods will be subjected to ruggedness testing at CEC according to ASTM E1169-89, Conducting Ruggedness Tests. This will include at the minimum, variables of temperature, loading, test configuration, and raw materials. To determine the coefficient of variance and significance of these parameters, a statistician will analyze the results. They will be subjected to a confidence limit of at least 95 percent for acceptance. This analysis may lead to modifications of the equipment and/or procedure.

TASK 4.0 PHASE II REPORT

This task will consist of preparing a report documenting the findings from this phase. A tentative outline for the report is given below;

1.0 Introduction
- Background
- Objectives
- Scope

2.0 Development of Preliminary Mix Design Procedure
- Revisions to the Mix Design Procedure
- Development of field tests and methods
- Construction Methods and Equipment

3.0 Ruggedness Testing
4.0 Conclusions and Recommendations
5.0 References

PHASE III PILOT PROJECTS AND IMPLEMENTATION

TASK 1.0 DEVELOP GUIDELINES AND SPECIFICATIONS

As identified in the RFP for this project, the successful contractor is to develop guidelines and specifications for the proper use and application of slurry surfacing and microsurfacing mixtures. Information acquired in Phases I and II of this study, as well as acceptable existing guidelines, will be reviewed and synthesized. The end result will be a new set of guidelines for the application of the specifications, including the new mix design framework, and additional guidelines for the application of slurry surfacing and microsurfacing in the field. To satisfactorily accomplish this task, it will be necessary to address a number of key issues that affect the constructability and overall performance of the mixes. The RFP has identified many of these issues and set the stage for their consideration within the new guidelines and specifications.

Task 1.1 Ensure Proper Mixing, Wetting, and Adhesion in the Field

Mixing, wetting, and adhesion (between the binder and the aggregate) are a function of the raw materials, the design, climatic conditions, capabilities of the equipment, competency of the contractor, and the condition of the existing pavement. Accordingly, some effort under this task will be directed at establishing recommended procedures for the equipment operator and inspector to make sure the component feed systems on the mixing equipment are properly calibrated and that the mixing chamber and pugmill are working properly. Wetting can relate to the chemistry of mix components, but we understand in this context it refers to the application of a very light spray of water in advance of the spreader box to facilitate bonding by breaking the surface tension on the pavement surface. Thus, it will be important to address this issue in the guidelines and provide instructions to the operator on the proper operation and adjustment of the spray bar.

The mix stiffness, chemistry, and ambient conditions affect the wetting characteristics of the mixture and its future performance. Consequently, guidance must be provided on the control of the mix proportions for both slurry surfacing and microsurfacing.

Adhesion of the mix to the existing surface is a function of the cleanliness of the pavement surface. Proper surface preparation techniques include the removal of oil and grease drippings, as well as “road kill” and any other dirt or debris that could adversely affect the bond between the surfacing and the pavement. Crack sealing should be done well in advance of the application of slurry surfacing and microsurfacing and over-banding should not be permitted. (Otherwise, the strike-off assembly of the paving box can easily pull up the sealant and contribute to finishing problems). Patches should be level with, or slightly below, the existing pavement surface. (Otherwise, a bump will appear in the final surface). Because of these factors, the guidelines will need to address the proper preparation of the existing pavement surface.

Task 1.2 Ensure Mixture Does Not Segregate During Field Application

Additional recommendations will be prepared and included in the guidelines for the operator and inspector under this task. The goal will be to address one of the most common causes of mix segregation with slurry surfacing and microsurfacing mixes, i.e., excess fluids in the mixture when placed in the spreader box. When this happens, the fine aggregate particles tend to “float” to the surface with the binder and the coarse aggregate settles. Excess moisture can be the result of an improper mix design or the addition of excess water by the operator. Generally, when the operator has to add water to the mix, he is doing it so that he can place and finish the surface. The addition of water is done to make the mix more workable, but can affect the cohesiveness of the mixture. The problem can certainly be addressed by exercising better water control during construction; however, it can also be addressed through additional criteria for the mix design.

Task 1.3 Ensure Homogeneous Spreading of Treatment Over Pavement Surface

Both slurry and microsurfacing are applied to the pavement surface with a spreader box that has a strike-off assembly to uniformly deposit the material. Some of the problems related to homogeneity can be addressed through improved, straight-forward guidelines or checklists for both the operator and inspector. These will be prepared under this task to address the proper operating characteristics of the spreader box and provide a list of ”do’s and “don’ts” along with photographs to aid in the identification of good and bad practice.

Task 1.4 Provide Guidance on Emulsion Curing Characteristics

The emphasis in this task is to develop guidance on curing that takes into account the many variables that affect it. These include the chemistry of the various systems, as well as the impact that field conditions, such as different surfaces, traffic volumes, and environmental conditions, have on curing.

Curing of the emulsion in slurry surfacing is different from curing of microsurfacing. Consequently, recommendations will be provided for each system that will address different surfaces, traffic, and environment. For example, the “break” and “cure” [1] of traditional slow setting slurry surfacing emulsions, SS grades [2], depends on the ambient temperature and humidity conditions. Evaporation can be very rapid in high temperature and low humidity. On the other hand, quick setting slurry emulsions, QS grades [2], depend on a combination of the emulsion chemistry and the ambient conditions. In contrast, microsurfacing emulsions depend primarily on the emulsion chemistry rather than on evaporation to “expel” the water from the system.

Both systems can be used on flexible and rigid pavements. Historically, microsurfacing has been used on higher volume traffic facilities because traffic can be placed on these mixes generally in less than an hour. This is in contrast to slurry surfacings that generally take longer to break and cure. The exception is a quick set slurry system that can handle traffic within 2-3 hours depending on the ambient conditions. Microsurfacing systems can be placed at night since they do not totally depend on evaporation for break and cure whereas slurry surfacings are confined to daytime placement.

Because of the great range in curing characteristics of the different systems and the different types of mixtures used in those systems, it is anticipated that the guidelines can be provided in tabular form, with appropriate recommendations for each of the mixes that are available. Additionally, guidance will address field conditions that affect curing characteristics, such as the surface type and ambient conditions.

Task 1.5 Provide Guidance on Appropriate Use of Treatments

While slurry surfacing and microsurfacing are very similar in many ways, in several respects they are quite different. Under this task, we will prepare and include recommendations (for incorporation into the guidelines) regarding the proper use of each system as it relates to traffic, environment, geometry and any other unique conditions that might differentiate the proper use of the two systems. We envision preparing a simple table that could be included in a shirt pocket size binder, similar to the one noted in Table 3.1.

Table 3.1 Placement, Environment, Traffic, and Geometry Guidelines

Pavement Conditions	Parameters	Slurry Surfacing	Quick Set Slurry Surfacing	Microsurfacing
Traffic (ADT/Lane)	<1000			
	1000<ADT< 4000			
	>4000			
Rutting	<1/4”			
	1/4<R<1”			
	>1”			
Fatigue Cracking	Low			
	Medium			
	High			
Longitudinal Cracking	Low			
	Medium			
	High			
Transverse Cracking	Low			
	Medium			
	High			
Surface Condition	Dry			
	Flushed			
	Bleeding			
Raveling	Low			
	Moderate			
	High			
Environment	Wet-Cold			
	Dry-Cold			
	Wet-Hot			
	Dry-Hot			
Geometry	Hills			
	Curves			
	Intersections			

Each of the parameters identified in this table would be described in detail, so that the user has a thorough understanding of what the various terminology (such as “low,” “medium,” and “high”) mean. When organized in tabular form, the resultant product could be used by the project manager to identify the feasible treatments for any specific site conditions, especially when linked with the guidance on curing time.

Task 1.6 Identify Characteristics that Ensure Long Term Performance

As noted above, slurry surfacing and microsurfacing are similar but do have some unique differences. The same can be said for long-term performance characteristics. Obviously, the two most important features relating to performance are the condition of the existing pavement where the mixture is to be placed and the quality of the components of the mix design. Consequently, under this task, we will prepare a detailed list of characteristics that are essential for long-term performance and can be related to performance. Among these characteristics are:

1. Pavement condition
    a. Type, severity, and extent of distress
    b. Age
    c. Structural capacity of the pavement
2. Mix design
    a. Binder type
    b. Binder content
    c. Aggregate gradation
    d. Aggregate type
3. Site conditions at and after placement
    a. Temperatures
    b. Rainfall
4. Traffic
    a. Traffic volumes
    b. Tires (e.g., chains and studded tires)

Consideration of these characteristics is likely to be covered in both the new guidelines and new specifications.

Task 1.7 Provide Guidance on Project Selection

Both slurry surfacings and microsurfacings have the capacity to extend life and improve the performance of an existing pavement. However, there are condition limits beyond which the use of either surfacing method should not be considered feasible. This is primarily because the presence of certain types of distress at moderate to high severity levels can cause either type of surfacing to deteriorate so rapidly that the costs associated with placement would be prohibitive. Work under this task will be directed at developing recommendations for characterizing pavement condition and identifying which pavements are the best candidates for slurry surfacings and microsurfacings.

For condition surveys, we anticipate using a distress identification manual such as the Strategic Highway Research Program Distress Identification Manual [3], Paver Asphalt

Distress Manual [4], or the TX DOT Rater's Manual [5] as a reference for identifying distress types, severities, and their extents. We will then prepare recommendations for agencies and contractors to use to assure that conditions are appropriate to place these mixes in order to obtain optimal performance.

1. To develop criteria for project selection, the project team will rely heavily upon its experience in conducting an investigation for the Foundation for Pavement Preservation [6], the National Cooperative Highway Research Program (under NCHRP Project 14-14, "Guide for Optimal Timing of Pavement Preventive Maintenance Treatment Applications"), and the development of two training courses on pavement preservation for the Federal Highway Administration's National Highway Institute [7, 8].

Task 1.8 Recommend Specifications for Use on Projects

Under this task, a complete set of recommended specifications will be prepared. As previously noted, these specifications will contain the mix design and constructability features identified in Phase II. Using these, we will develop a set of guidelines on the use of the specifications for both slurry surfacing and microsurfacing. The International Slurry Surfacing Association has published recommended performance guidelines for emulsified asphalt slurry seals [4] and microsurfacing [5]. Several states that use a large volume of these systems have also developed specifications. We will evaluate these as well as other international specifications and use them as a starting point to generate a broad-based specification.

TASK 2.0 DEVELOP A TRAINING PROGRAM

As noted in the RFP, the contractor is to develop a comprehensive training package that includes a manual and a workshop that is to include a pre-construction module. Fugro-BRE, Mactec, and APTech have extensive experience with the development of training courses and materials. Samples of previous work in this area are provided in Section 6, Project Experience / References.

Task 2.1 Develop a Training Workshop that Incorporates all Aspects of Slurry/Microsurfacing for a Wide Range of Target Audiences that Includes Transportation Agencies, Contractors and Suppliers

In this task, we will develop a total training package designed to educate and inform agency personnel (at several levels), contractor personnel, and material suppliers. The package will include as a minimum:

- Training manual containing the following sections
    - Introduction to slurry surfacing and microsurfacing
        - How and why the systems work
    - Project selection criteria with photographs indicating proper and improper conditions and guidance on the use of selection tools
    - Pre-construction requirements
    - Specifications for slurry surfacing and microsurfacing
    - Mix Design criteria for slurry surfacing and microsurfacing

        - Binder requirements
        - Aggregate requirements
        - Blending requirements
    - Test Methods and Procedures
        - Framework, mechanisms, and significance of the test variables
        - Hands on training with the test methods
    - Construction considerations and limitations
        - Project geometry
        - Weather limitations
    - Construction operations
        - Surface preparation
        - Equipment and calibration requirements
        - Mix design verification
        - Stockpile management
        - Troubleshooting
        - Inspection and workmanship requirements
    - QC/QA requirements
        - Pre construction and construction testing requirements
        - Frequency and type of test
    - Appendices
        - Test methods
        - Specifications
        - Other relevant literature
- Visual Aids
    - Microsoft PowerPoint presentation for each training module
    - Digital video clips used to demonstrate recommended lab test procedures and construction/placement practices
    - Viewgraphs for any associated workshops or hands-on training sessions
- Instructors Manual
    - Printed images of all the visual aids
    - Instructor notes for all presentation materials (could be used in "train the trainer" sessions for instructors)

At this time, it is not clear whether the actual presentation of the training course will be required as part of this project. If it is, the length of the course and its location will need to be determined.

Task 2.2 Develop a Pre-Job Training Module for Inspectors and Contractor's Staff

During the development work for Task 2.1, a good deal of "must know" information for agency and contractor personnel will be examined and amplified. This information will then be extracted and a stand-alone document prepared for a training workshop (similar to a pre-construction meeting) that will be held prior to the beginning of a slurry surfacing or microsurfacing project. In addition, an easy to use, pocketsize guidebook will be prepared so that both agency and contractor personnel can take it into the field.

Fugro-BRE and Mactec have extensive experience with the development of these types of tools.

TASK 3.0 CONSTRUCT PILOT PROJECTS FOR VALIDATION OF THE PROCEDURES

Under this task, the mix design procedures developed under Task 1 of Phase III will be "field tested" by constructing projects in various environmental regions throughout the United States. This is to insure that the procedures are adaptable for construction conditions and that there is a relationship between mixes made in the laboratory and those produced by the mixing equipment in the field.

Task 3.1 Identify State Highway Departments that are Interested in Sponsoring and Constructing Pilot Projects

The RFP states, "there will be at least 12 States involved in which field work will be necessary. At this time, those states are: California, Georgia, Illinois, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, New Hampshire, New York, and Vermont". During this task, each of the States noted will be contacted to determine their continuing interest in sponsoring and constructing pilot projects for slurry surfacing and microsurfacing using the new procedures developed under this contract. Provided they are still interested, we will proceed with supplying them the necessary information, documents, and training materials so that they can begin the planning for this effort. Should one or more of these States indicate they are no longer interested in participating, we will solicit pilot projects from other States with similar environmental conditions. Preconditions for selection should include:

- Contractor availability
- Availability of emulsions and aggregates
- Equipment considerations
    - o Continuous machine
    - o Truck mounted machine

It is presumed that the construction will be part of a normal field project let by one of the participating State agencies. The contractor or the agency will provide all the QA. A member of this project's team will be available to collect data only to verify the applicability of the mix design procedure.

Task 3.2 Identify Candidate Test Sites that Represent Various Climatic and Traffic Conditions.

To obtain the maximum benefit from the field experiment, a statistically based experiment design will be carried out as the first major activity in this task. The end result of this will be target set of test sections that can supply valuable data in a format that can permit the engineers and statisticians to draw statistically valid conclusions about the impact of such factors as:

- Condition of the Existing Pavement (prior to treatment)
- Soil Strength

- Structural Capacity of the Existing Roadway
- Mix Design
- Climate
- Traffic

To develop the experiment design, levels of these (and any other important factors) will be defined. For example, we may identify three different levels of condition involving explicit combinations of cracking, rutting, and ride quality. Similarly, we might define two levels each of soil strength, structural capacity, mix design, and traffic. For climate, we would likely select the four FHWA LTPP climatic zones of wet-no freeze, wet-freeze, dry-freeze, and dry-no freeze. An illustration of the experiment design matrix associated with these 6 factors (and their example levels) is presented in Table 3.2.

Table 3.2 Illustration of Possible Experiment Design Matrix

Climate	Traffic	Surface Type	Condition											
			Poor				Fair				Good			
			Soil Strength											
			Low		High		Low		High		Low		High	
			Structural Capacity											
			Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
Wet/ No-Freeze	Low	Slurry												
		Micro												
	High	Slurry												
		Micro												
Wet/ Freeze	Low	Slurry												
		Micro												
	High	Slurry												
		Micro												
Dry/ No-Freeze	Low	Slurry												
		Micro												
	High	Slurry												
		Micro												
Dry/ Freeze	Low	Slurry												
		Micro												
	High	Slurry												
		Micro												

This example matrix shows 192 possible combinations of the different factors and their levels. Obviously, available funds within the project will not cover an experiment of this magnitude. Consequently, the challenging part of this task will be to identify select cells (treatment combinations) that will provide a sound basis for addressing some of the key issues relative to slurry surfacings and microsurfacings. To that end, we have included a noted statistician, Dr. Charles Antle, on the team. Depending on the number of test sections and the experimental factors that are finally selected, it will be possible for Dr. Antle to define a fractional experiment design with certain cells targeted for construction and future monitoring. Dr. Antle will also address the need for section replication as part of the development of the overall experimental plan (Dr. Antle will also assist in the analysis of the data to ensure that statistically-valid observations and conclusions are made).

Working with our contacts within the states that have agreed to participate in sponsoring and constructing pilot projects, we will provide criteria for individual section selection. (For purposes of this proposal, we have assumed that twelve pilot sections will be required). Once selected, we will work with the states to ensure that the as-constructed pilot sections satisfy the experimental criteria.

Task 3.3 Develop a Performance Evaluation Plan

For data collected from each of the twelve pilot sections to be evaluated in a systematic and comprehensive manner, a pavement performance evaluation plan must be developed that can be implemented at each site. To accomplish this task, we propose to use experimental design techniques in the collection and analysis of performance data. The evaluation plan would contain, as a minimum, the following:

- Pre-Construction
  - Project location and base environmental conditions
  - Typical section[s]
  - Construction history, including materials
  - Current daily traffic, including truck percentages
  - Condition survey by FHWA-certified raters or other means
    - Cracking
    - Rutting
    - Ride quality
    - Friction [where possible]
  - Determine the “evaluation section” within the test section
  - QA procedures developed in Task 1

- Post-Construction – Short term (immediate)
  - Breaking and curing rate
  - Permeability using the Louisiana Transportation Research Center or National Center for Asphalt Technology test method
  - Texture using sand patch or other accepted test procedure
  - Noise
  - Visual observation, stone loss, joints, etc.

- Post-Construction – Long term (after I year of service)
  - Condition survey of evaluation section
  - Rutting
  - Ride quality
  - Noise

A form will be prepared, similar to the example presented in Table 3.3 and used to help ensure that the characteristics and other required data for each section are collected and recorded.

Another issue related to the performance evaluation plan is section length. This is an issue that will again be addressed with the assistance of Dr. Antle to ensure that an adequate sample is established. For purposes of this proposal, however, we have assumed that the section length will be 0.76 km (2500 ft).

Table 3.3 Evaluation Plan Elements

Slurry Surfacing/Microsurfacing Project Evaluation				
Date				
Observer				
Project Location				
Environmental Zone				
Typical Section				
Original Construction Date				
		Pre-Construction	Post Construction (Short Term)	Post Construction (Long Term)
Cracking				
Fatigue	Low			
	Moderate			
	High			
Longitudinal	Low			
	Moderate			
	High			
Transverse	Low			
	Moderate			
	High			
Rutting	< ¼”			
	¼”<R<1”			
	>1”			
Ride Quality (IRI)				
Texture				

It is anticipated that experienced representatives of the project team will be present at each phase of the pre-and post-construction portions of the pilots

Task 3.4 Conduct a Pre-Construction Training Program for Agency Inspectors and Contractor Personnel

Prior to the actual construction of the slurry surfacing and microsurfacing pilot sections, the pre-construction training module developed in Task 2.2 of this Phase will be presented for agency inspection and contractor personnel to acquaint them with the project provisions, QA requirements, and placement guidelines.

Task 3.5 Revise the Procedures Based on the Performance of the Test Sections

During this task any of the procedures developed during Phases II and III that are deemed incomplete or unacceptable will be revised, modified, or eliminated based on the performance information gathered during or immediately after construction, or after the one-year performance period.

Task 3.6 Revise the Training Program as Necessary

In concert with Task 3.4, procedural issues or problems identified in Task 3.3 will require that modifications be made to the training materials developed in Task 2.

TASK 4.0 PROVIDE A REPORT DOCUMENTING THE WORK CONDUCTED IN ALL PHASES

Under this task, we will first prepare a draft final report that documents the overall findings of the study, and presents our conclusions and recommendations. As illustrated in the draft outline presented in Table 3.4, all key elements of developing the revised mixed design procedure, experiment design, data collection, analysis, training, and research will be included.

Table 3.4 Draft Outline for Final Report

1. Introduction
    a. Background
    b. Objectives
    c. Scope
2. Development of Preliminary Mix Design Procedure
3. Development of Experimental Design and Data Collection Plans for Field Investigation
4. Summary and Analysis of Data from Pilot Section Construction and Performance
5. Calibration and Refinement of Mix Design Procedure
6. Conclusions and Recommendations

Three months before the end of the contract period, the draft final report will be submitted for review and comment. After a one-month review, a day-long meeting will be held to review the comments and to decide how the comments should be addressed. A final report will then be submitted prior to the end of the contract.

Section 4
Personnel

PERSONNEL

This section identifies all personnel who will be working on the project. It includes their titles, qualifications, a summary of similar work on studies performed, and an estimate of the hours to be worked by task. Detailed resumes for key personnel are provided in the appendix. Table 4.1 provides the level of effort for each team member by phase and task.

James Moulthrop (Project Manager, Fugro-BRE)

James Moulthrop has over 39 years experience in the transportation field with a particular emphasis on management and asphalt paving systems. While working with the Pennsylvania Department of Transportation, he was actively involved in the development, implementation, and training associated with research projects including restricted performance specifications, friction assessment of aggregate sources, and the roadway management system. As the Director of the Materials and Testing Division, he managed a staff of 225 professionals and technicians and while Director of Highway Maintenance he was responsible for a $450 Million budget and a staff of 45 professional and administrative employees.

While employed by the University of Texas at Austin, he served as the program manager for the Technical Assistance contract portion of the Strategic Highway Research Program. In this role, he was responsible for the timely completion [within budget] of the research activities for over 15 major research organizations involved with the project.

Jim Moulthrop has been very active in all aspects of slurry surfacing and microsurfacing. From 1994 to 1998 he was a full time consultant to a German chemical company, Rashig AG, who specializes in the manufacture and application of emulsifiers for slurry surfacing and microsurfacing. His role was to work with suppliers and contractors using a microsurfacing emulsion called Ralumac. In this role he provided technical support for the design and application of the product throughout the US and Canada and participated in numerous meetings with agencies providing training in selecting the proper project on which to place these products and their correct application techniques.

In July 1998 he joined Koch Materials Company as a pavement system leader in their southern regional office. In this role, he was active in the promotion and placement of microsurfacing and other paving systems developed or purchased by Koch Materials Co. In addition, he made numerous technical presentations and authored several papers on the proper use of microsurfacing

Glynn Holleran (Co-Project Manager-APTech)

Glynn Holleran has over 20 years experience in surface treatments and materials. He completed a bachelor's degree in Applied Science with majors in industrial chemistry and minors in chemical engineering, economics and business management. He completed a Masters degree in polymer rheology also at the University of Melbourne. Mr. Holleran spent 6 years with ICI Australia in polymer research and 3 years in adhesive applications with The Roberts Company of Australia. In 1985 Mr. Holleran joined Mobil Oil Australia working in all aspects of asphalt technology over 11 years. This included asphalt chemistry, polymer modified binders, emulsions and cutbacks. Applications included hot mix, chip sealing, micros urfacing and slurry seal, foamed asphalt and cold mix. He controlled all design and formulation functions as well as research and development for the group and its Contracting company- Emoleum Australia. He became the Group Technical Manager for the bituminous products group responsible for technical issues for Mobil refineries in Australia as they related to asphalt. Mr. Holleran reintroduced slurry systems in Mobil in Australia. One successful project, which he led, revolutionized Mobil's asphalt manufacturing in 1992. At this time Mr. Holleran also served as the asphalt consultant for Mobil International carrying out projects in USA, Africa, New Zealand, Europe and Asia.

He was very active in the Australian industry and internationally representing the company on Australian and International bodies. (Austrians, AEMA, ISSA, ISAP, Australian Standards). He developed with these bodies' specifications and test methods for emulsions, cold mix, foamed asphalt and polymer-modified binder. As the chairman of the Australian Asphalt Pavement Association he was involved in developing the Australian mix design method.

In 1995 he came to USA and became Technical Manager and Vice President for Technology and International Operations and for Valley Slurry Seal Company. He has been involved in successful emulsion, microsurfacing and slurry introductions in China, Russia, Romania, Thailand, Japan, Korea, New Zealand, Sampan, Mexico, and Chile as well as many projects in USA. This included full project management including equipment, design, and application on site and technology transfer.

In 2001 He joined LAW Crandall to advise Caltrans . He has revived the Caltrans pilot study on Microsurfacing and has written a detailed Technical Advisory for maintenance treatments. Mr. Holleran has written widely on the subject of emulsions and presented seminars in many countries. He is a member of ASTM D04.

Steve Seeds (APTech)

Mr. Steve Seeds, P.E. serves as a Program Director in Applied Pavement Technology's Reno, Nevada, office. He specializes in pavement structural evaluation/design and projects dealing with performance-related specifications, statistical analyses, performance prediction model development, design procedure development, software development and axle load damage assessment.

Mr. Seeds has been involved with pavement design, research, evaluation, construction, and management projects for well over 20 years. He has served as a Principal Investigator on several studies of national implication and has managed the research group for two major U.S. pavement engineering/research firms. He currently is chairman of TRB Committee A2B03 on Flexible Pavement Design.

Mr. Seeds has served as a Principal or Co-Principal Investigator on six projects for the Federal Highway Administration (FHWA) and National Cooperative Highway Research Program

(NCHRP). Recently, he completed his role as Co-Principal Investigator in the FHWA/NCHRP project entitled "Accelerated Field Test of Performance-Related Specifications for HMA Construction" (a.k.a, WesTrack Project). Recently, Mr. Seeds completed his leadership role on four other studies of national significance. The first three involve the development of two new training courses for the National Highway Institute entitled, "HMA Construction," "HMA Pavement Evaluation and Rehabilitation," and "Asphalt Pavement Recycling Technologies." Each of these will be presented to federal, state, local and private agencies throughout the U.S. He is also serving as the Principal Investigator in an NCHRP research project named, "LTPP Data Analysis: Significance of As-Constructed AC Air Voids to Pavement Performance" which is targeted at establishing the sensitivity of pavement performance to the quality of field compaction of hot-mix asphalt mixtures.

Haiping Zhou (MACTEC)

Dr. Haiping Zhou has over eleven years of experience in pavement design, evaluation and research. After completing both his masters and doctorate level studies at Oregon State University, he undertook various design projects for the Oregon Department of Transportation as a pavement design specialist. He has performed over thirty major pavement design projects, including both new design and rehabilitation. In addition to his work for Oregon DOT, Dr. Zhou has performed pavement structural evaluations and rehabilitation designs for the City of Reno, El Dorado County of California and Vandenberg Air Force Base in California. Currently, he is performing pavement design work for the Oklahoma Turnpike Authority. He has also been an Instructor on a National Highway Institute Short Course - Techniques for Pavement Rehabilitation. He was also a senior research engineer on the FHWA project Accelerated Field Track Testing for Performance Related Specifications (WesTrack) for Hot Mixed Asphalt Construction. He has considerable experience in pavement evaluation using nondestructive testing techniques through back calculation analysis and other state-of-the-art techniques.

In addition to his practical design application work, Dr. Zhou has undertaken pavement research in areas of mechanistic analysis, back calculation, overlay design, rubber modified asphalt concrete pavements, free draining base materials properties and polymer modified asphalt concrete pavements. He has conducted a substantial amount of laboratory tests relating to material properties of asphalt concrete mixtures, crumb rubber modified materials, aggregate and soils. He has also developed a considerable number of applied computer programs for civil engineering applications.

Dr. Zhou is currently a senior engineer on the Federal Highway Administration Long-Term Pavement Performance Technical Support Services Contract and is task leader in pavement instrumentation, which includes the Seasonal Monitoring Program, Automated Weather Stations, and Dynamic Load Response. Other assignments include special information management system (IMS) functions, quality control (QC) of LTPP data, and development of LTPP computer software, and other special projects. He has over seven years of direct experience on the LTPP program, with particular emphasis on the pavement instrumentation and seasonal monitoring program.

Rita Leahy (MACTEC)

Dr. Leahy is a Senior Project Manager at Mactec and leads the materials research and testing and technology transfer groups and the strategic planning effort. Dr. Leahy works closely with clients to implement new technology and concepts: Superpave, performance-related specifications, and design-build-maintain strategies.

Dr. Leahy has been actively involved in the transportation industry on pavement related issues at the national, regional and state levels for more than fifteen years in various capacities: Civil Engineering faculty at Oregon State University, Senior Staff Engineer with the Strategic Highway Research Program, and Principal Engineer with the Asphalt Institute. She serves as chair or member of several TRB committees and NCHRP panels.

Specifically, Dr. Leahy has authored or co-authored numerous publications on pavement analysis and design, asphalt technology, and materials characterization. She was actively involved in both in-house and contract research, a substantial portion of which was associated with the SHRP asphalt refinery survey. Her primary responsibilities in support of this research were data gathering and analysis. Dr. Leahy often was called upon to conduct forensic studies of pavement failures.

Gary Hicks (MACTEC)

Dr. Hicks has over 35 years of experience in research and practical training in the areas of pavement materials, pavement design and evaluation, maintenance and rehabilitation of highway pavements. He has worked on significant projects such as the 1972 and 1986 AASHTO Guide for Design of Pavement Structures and was project manager for Phase 1 of the AASHTO 2002 Design Guide (NCHRP Project 1-34). Upon completing his Ph.D. in 1970, he joined the faculties of civil engineering at Georgia Tech in 1971 and Oregon State University in 1975. During this period, he supervised and/or carried out transportation research projects totaling over $15 million.

Dr. Hicks has participated in many projects related to mechanistic design, recycling of asphalt pavements and the maintenance and rehabilitation of highway pavements using innovative materials. In the past several years he has served on the Board of Directors for the International Society of Asphalt Pavements and the Foundation of Pavement Preservation, where he served as principal investigator on a project dealing with the selection of the appropriate maintenance treatment for flexible pavements. Dr. Hicks also played a major role on the $10 million SHRP Project A-003A entitled Performance-Related Testing and Measuring of Asphalt-Aggregate Inter-actions, and served as a principal investigator in a $2.5 million FHWA contract titled Crumb Rubber Modifiers in Asphalt Pavements. He recently completed the development of an asphalt pavement design guide for use by local agencies and consulting firms and a life cycle cost study for asphalt pavements containing modified materials.

Dr. Hicks is considered an authority in pavement design and pavement maintenance and rehabilitation. As such he has served as expert witness on a number of cases representing both agencies and contractors alike. He has an outstanding record of success in these types of disputes.

He has authored numerous publications in these areas and has lectured throughout the world on these topics. He is co-author with Clarkson Oglesby of a textbook *Highway Engineering*. He is also active in professional organizations such as the Transportation Research Board (TRB), the Association of Asphalt Paving Technologists (AAPT), American Society of Civil Engineers (ASCE), International Society of Asphalt Paving (ISAP) and the Foundation for Pavement Preservation (FPP).

Sam Huddleston (Lab Manager – MACTEC)

Mr. Huddleston joined LAW in May 1994. He is the Bituminous Laboratory Manager responsible for the materials testing of a variety of asphalt products. Mr. Huddleston has been responsible for expanding our services of asphalt product testing to include viscosity grading, aged residue, performance based asphalt, performance grade asphalt, polymer modified asphalt, emulsions, polymer modified emulsion, high float emulsions, cutback asphalt, emulsified rejuvenating agents, asphalt rubber blend designs, slurry seals, micro seals, roofing asphalt, bituminous marker adhesive, tape sealants, forensic studies, and recovery of asphalt binders (Abson and Rotavapor).

Mr. Huddleston has been the project coordinator for several state and federal projects. These include:

- FAA QC/QA experience on the North Runway project at Sky Harbor International Airport
- Federal Highway Administration (FHWA) Long Term Pavement Performance (LTPP) and Specific Pavement Studies (SPS) projects in more than 15 states
- He is also the project coordinator for the Florida Department of Transportation (FDOT) recycling contract, which he has managed for 4 years
- Mr. Huddleston has also managed a contract for the Western Federal Lands Highway Division of FHWA for 3 years to perform on-call asphalt binder testing

Mr. Huddleston has been instrumental in our quality services by overseeing our ADOT, AMRL, and CCRL accreditation programs to include inspection and proficiency testing. He currently serves as a Corporate Calibration Committee Member involved with updating and reviewing the Corporate Calibration Manual.

Mr. Huddleston has an extensive background in quality assurance and materials testing through his solid educational background in quality assurance, and extensive work experience in performing quality assurance testing for a ready-mixed concrete producer in Virginia. As a validation engineer for a major pharmaceutical company in North Carolina, Mr. Huddleston has been responsible for the development and evaluation of testing protocols under FDA guidelines.

Carol Goldman (Lab Manager – CEL)

Carol Goldman came to Consolidated Engineering Laboratories in May of 2001. The CEL management and ownership has been extremely supportive of Carol as she expands CEL's services into testing and inspection of asphalt emulsion, slurry seal and microsurfacing materials. As a Laboratory Manager for the Soils/Asphalt division within the laboratory, she concentrates in providing emulsion technical support and testing services on Quality Control/Quality Assurance programs for agencies and contractors. As a NICET (National Institute for Certified Engineering Technologies) certified technician, Carol continues to provide laboratory testing while overseeing the laboratory operations and providing technician training.

In 1997, Carol Goldman began providing presentation support on the ISSA's Slurry Systems Workshop Committee. Since 1998, she has lead half-day sessions for "Trial Mixing and Laboratory Equipment".

Prior to coming to CEL, Carol worked at Reed & Graham Laboratories for six years, where she performed numerous slurry seal and microsurfacing mix designs for clients locally, nationally and internationally, performed extensive QC/QA testing for over 25 agencies annually, and performed emulsion research and development for private businesses.

Carol Goldman has been involved in testing, evaluating, reporting, and investigating pavement and road base materials since 1983. She has conducted extensive laboratory work and inspections in hot mix asphalt, emulsion, aggregate, soils, and concrete.

David Peshkin (APTech)

Mr. Peshkin is a Principal with Applied Pavement Technology, Inc. (APTech) and has over 15 years of experience in pavement research, engineering projects, and technology transfer activities. Over the past 10 years, much of his work has focused in the pavement preservation area. That has included having primary responsibility for developing several new training courses for the Federal Highway Administration (FHWA) on pavement preservation: The Preventive Maintenance Concept, Selecting Pavements for Preventive Maintenance, and Design and Construction of Quality Preventive Maintenance Treatments. He is also the Principal Investigator for NCHRP Project 14-14, Optimal Timing of Preventive Maintenance, which is focusing on developing guidelines for determining the best time to apply preventive maintenance and developing an experimental plan to evaluate various treatments.

Charles Antle (APTech)

Dr. Antle is a Professor Emeritus of Statistics at Pennsylvania State University, having retired in 1992. He is currently serving as a statistician on several funded research projects related to asphalts and asphalt pavements. He provided statistical assistance in the review of numerous experiments in the SHRP program. He has a wide range of interests in the application of statistical procedures for the analysis of experimental data including linear and non-linear modeling, the analysis of variance, logistic modeling and reliability analyses. He is a long time user of Minitab and SAS for the analyses of experimental data.

Tim Martin (BRE-Fugro)

Tim Martin, an employee of Fugro-BRE for the past 6 years, was awarded the Young Engineer of the Year award by the Travis Chapter of the Texas Society of Professional Engineers. This award is given to Tim because of his excellent work as a young professional engineer in the community.

At Fugro-BRE, Tim has become a key member for providing pavement management services. Recently, Tim has been responsible for implementing pavement management systems for numerous cities and has personally conducted over 1000 pavement condition surveys. Tim has been heavily involved in the research, evaluation, analysis and design of pavements. Tim has performed structural evaluations and pavement designs of highways, airfields and port facilities.

In addition to his work, Tim is an active member in the Travis Chapter of TSPE and has served on the board in many different capacities for over 6 years. He has been the Scholarship Chairman, served as Student Liaison, Associate Member Director, State Director, member of the Math Counts Committee, member of the National Engineering Design Challenge/Texas Engineering Challenge, and now currently presides as Vice President.

When not at work, Tim contributes his time and resources to many charitable causes. From the Christmas food drive, adopt a child, and "say no to drugs" program to participating in the Capital 10K and MS150 raising funds to find a cure for those with Multiple Sclerosis. In his spare time, Tim enjoys spending time with his family, traveling, cycling, and listening to music.

Brian Killingsworth (Fugro-BRE)

Mr. Killingsworth joined Brent Rauhut Engineering (now Fugro-BRE, Inc.) in 1992 while pursuing a Masters Degree in Civil Engineering, which he completed in 1994. His current duties include pavement related research studies, construction specification review and development, equipment operation and evaluation, computer programming, pavement design and evaluation, materials design, evaluation and analysis, and other pavement related data analysis. Mr. Killingsworth is knowledgeable in model development for materials characterization and pavement performance prediction. He also has practical HMA construction and field experience on several projects, including quality control (QC) at Westrack.

Mr. Killingsworth's research activities include several National Cooperative Highway Research Program (NCHRP) and Federal Highway Administration (FHWA) studies where he currently serves or has served as the Principal Investigator, Field Engineer and/or Data Analyst. Mr. Killingsworth has provided training to various agencies and individuals over the last few years. He has had the opportunity to speak at many conferences, educational seminars and technical meetings on a variety of pavement engineering topics. These topics include:

- Pavement Design and Type Selection
- Falling Weight Deflectometer (FWD) Data Collection and Analysis
- Life-Cycle Cost Analysis of Pavements
- Hot-Mix Asphalt Design and Testing
- Quality Control and Acceptance of Hot-Mix Asphalt Pavements
- Pavement Construction Specification Development and Review

Along with the research activities, Mr. Killingsworth has been responsible for Fugro South's Superpave laboratory. He selected the equipment for the lab, setup the mixture design procedures and currently provides technical direction and review of all hot-mix testing related to Superpave. The American Association of State Highway and Transportation Officials (AASHTO) also currently accredit the laboratory for hot-mixed asphalt materials and aggregates.

Weng On Tam (Fugro-BRE)

Dr. Tam started his graduate studies at the University of Texas at Austin in January 1997 and worked on several research projects at the University of Texas' South Central Superpave Center over a span of three years. During this time, he also provided training to participants of the Superpave training courses held at center as well as classroom instruction for graduate and undergraduate classes at the University of Texas at Austin. Participants in these classes include state DOT personnel, paving contractors, material suppliers, consultants, graduate, and undergraduate students.

Working at the South Central Superpave Center, Dr. Tam has significant experience with Superpave mixture design procedures and binder selection specifications as well as the Superpave test equipment. He is currently responsible for managing Fugro-BRE's asphalt testing clients and provides technical oversight for the Fugro-South's AASHTO (and A2LA) accredited asphalt testing laboratory. This includes interaction with the clients as well as the scheduling, supervision, and technical review of all the test results.

Dr. Tam joined Fugro-BRE April 1999 where his duties include asphalt concrete and pavement related research studies, traffic data review and analysis, pavement design and evaluation, asphalt concrete mixture design, pavement failure investigations, pavement-related data analysis, and course development and delivery.

Dr. Tam's research activities include several National Cooperative Highway Research Program (NCHRP), Federal Highway Administration (FHWA), and state-sponsored studies. He currently serves as the Co-Principal Investigator on *NCHRP 9-30 – Experimental Design* *for Calibration and Validation of Hot-Mix Asphalt Performance Models for Mix and Structural Design*.

Table 4.1 Summary of Personnel Requirements by Task

Name	Phase 1		Phase 2				Phase 3				Total
	Task 1	Task 2	Task 1	Task 2	Task 3	Task 4	Task 1	Task 2	Task 3	Task 4	
James Moulthrop	50	100	90	140	32	230	200	100	180	270	1392
Glynn Holleran	150	120	150	150	50	50	220	40	50	40	1020
David Peshkin								100		50	150
Steve Seeds								200			200
Sam Huddleston			100	50		50					200
Carol Goldman			260	180	120	40				40	640
Charles Antle					40				40	20	100
Tim Martin							50	50	80	80	260
Haiping Zhou							50	50	50		150
Rita Leahy		40				80				100	220
Brian Killingsworth	50	80	40	90		80	80	80		10	510
Weng On Tam		80	90			80	40	200		65	555
R.G. Hicks		40								40	80

Section 5
Facilities & Resources

FACILITIES AND RESOURCES

This section includes a description of the facilities and other resources that the Fugro-BRE Team can offer in support of this project.

FUGRO-BRE

Fugro-BRE employs advanced pavement engineering strategies and technologies to respond to the changing demands of the transportation industry. The professionals at Fugro-BRE continue to make significant contributions to the development of innovative procedures used to develop these capabilities: pavement design, evaluation, and field investigations; data collection, management, and analysis; nondestructive testing; material sampling and laboratory testing; pavement management systems; and a broad range of pavement related research.

Fugro-BRE is part of the Fugro family, a multinational consulting group. This teaming of services demonstrates Fugro's commitment to provide support technology to the transportation industry. As part of the Fugro organization, our resources extend throughout most regions of the world. The group's activities are carried out on land, at sea and in the air, and include the gathering and interpreting of data, geotechnical and materials engineering, and the providing of precise positioning services.

Fugro-BRE and Fugro South jointly occupy 27,000 square feet of company-owned office space located at 8613 Cross Park Drive in Austin, Texas. These facilities include offices for professionals and other staff, multiple conference rooms, multiple reproduction areas, a computer room housing the Local Area Network (LAN) and access to the Fugro Wide Area Network (WAN), a comprehensive Technical Reference Library and multiple secretarial/word processing stations. In addition, the building includes three large laboratories for testing soils, concrete and hot-mix asphalt. The offices are located near U.S. 183, providing easy access to Austin-Bergstrom International Airport and other areas of Austin.

Field Equipment

Fugro-BRE is involved in a wide range of field data collection activities that includes deflection measurements used for pavement evaluation. The deflection data is obtained from the Fugro-BRE owned Dynaflect trailer and the Dynatest Falling Weight Deflectometer (FWD). Both pieces of equipment are used to measure the response (deflections) of pavement structures under different applied loads. The Dynaflect trailer applies a small cyclic load, whereas the FWD applies an impact load up to a maximum of 25,000 pounds. Fugro-BRE also operates two FWDs on a full-time basis for the Federal Highway Administration (FHWA) within the Southeastern U.S. through a long-term pavement-monitoring contract.

Fugro-BRE currently operates a KJ Law Road Profiler on a full time basis for the FHWA. With this device roadway profile measurements are obtained and used to determine the Pavement

Serviceability Index (PSI) and International Roughness Index (IRI). In addition, the company owns and operates a Texas Department of Transportation accredited KJ Law lightweight profilometer to determine IRI and other smoothness parameters.

Fugro-BRE owns a mini video camera system for the inspection of highway underdrains and other drainage systems and owns sophisticated survey equipment and handheld GPS units to gather elevation data on construction and environmental study projects. In addition, Fugro-BRE has digital and still video capabilities.

Our newest addition has been the *ADV*antage, or Automatic Distress Vehicle, the first fully automated digital pavement distress surveying system. The *ADV*antage gathers high-resolution digital images of the pavement using a system of synchronized strobe lights and a digital cameral. The ADVantage can cover 100% of the pavement surface at highway speeds on lanes up to 14 feet in width. In addition, the *ADV*antage is equipped with a ride bar to collect profile data, and a camera is mounted in front of the vehicle to capture right-of-way data.

Office Equipment and Computer Hardware/Software

A full range of office furniture and equipment is available including copy machines, facsimile machines, binding equipment, word processing equipment, laser printers, color printers, scanners and typewriters.

Fugro-BRE has a substantial library of computer programs to support common data processing and computational activities. Access is available to the large DIALOG on-line database for literature searches. GUI libraries such as Microsoft Visual Basic and Visual C++ are used as computer programming platforms. Graphics software currently available includes PowerPoint, Freelance Graphics, Microsoft Visio, AutoCAD 2002, gINT, Adobe Photoshop, and Adobe Pagemaker. Several spreadsheet programs like Microsoft Access, Excel, and Lotus 1-2-3 are available for generating plots and graphs. High quality graphical output may be obtained from both color and black/white LaserJet and InkJet printers.

Database and spreadsheet programs are in everyday use. The JMP graphics package is used as the primary analysis system for data analysis and provides a multitude of statistical approaches to the wide array of data to be analyzed. Other statistical packages are part of the software library.

Computer hardware includes numerous high-speed computer systems, all with substantial memory, hard disks, and backup facilities. CD/DVD writers are used on a frequent basis for backup and transmittal of data to clients. Fugro-BRE computers are internally connected via a local area network and are part of the Fugro-wide area network that links all Fugro Companies worldwide. Electronic mail and Internet access are provided throughout the network.

Fugro-BRE has the capability of transferring graphical images to its computers by utilizing digitizing and scanning equipment. The images can be brought up in various software packages for inclusion in training materials or client reports. Other multimedia capabilities are available such as the conversion of computer presentations to digital video.

Technical Reference Library

The Fugro-BRE library includes many documents published by the FHWA, NCHRP, TRB, ASTM, AAPT, FAA and AASHTO in the areas of Fugro-BRE's technical expertise, as well as hundreds of documents from universities, State agencies, and foreign pavement research agencies. It includes proceedings from numerous specialty conferences worldwide. Due to participation of Fugro-BRE staff on technical committees, many documents are distributed to Fugro-BRE directly, while others are continually ordered to maintain a current library.

Laboratory

The Fugro laboratory facilities are maintained by Fugro South, which has multiple offices in Texas including Dallas/Ft. Worth, Waco, Austin and San Antonio. The Austin office provides several thousand square feet of laboratory space for soils and concrete testing and contains a comprehensive asphalt-testing laboratory that includes a full complement of Superpave testing equipment. In addition to the central laboratory facilities, Fugro South maintains mobile asphalt trailers capable of operation at a hot mix facility.

The Superpave laboratory is fully equipped to conduct Superpave performance grading of asphalt binders and Superpave volumetric mixture design of asphalt paving mixes (including aggregate characterization). In addition, it maintains standard equipment necessary for aggregate grading and Marshall and Texas Gyratory hot-mix asphalt mixture designs. The hot-mix laboratory is currently accredited by AASHTO for the tests listed in Table 5.1.

AASHTO personnel conducted the initial review process in September 1998 and accreditation was completed in early 1999. The laboratory facility accreditation is currently valid and Fugro maintains the accreditation annually as required by AASHTO. Fugro South has participated in the AMRL Reference Sample Program for Marshall mixture design for the past several years and submits reference samples for the Superpave Gyratory and the Superpave binder tests as well. In addition to the AASHTO proficiency samples, the hot-mix facility participates in other proficiency programs including the Western Cooperative Test Group program.

Table 5.1 Fugro's AASHTO-Approved Hot Mix Laboratory Tests

Asphalt Cement	**Hot Mix Asphalt Concrete Aggregates**	**Hot Mix Asphalt Concrete**
Specific Gravity	Washed Sieve Analysis	Quantitative Extraction
Dynamic Shear Rheometer	Sieve Analysis of Fine and Coarse Aggregate	Mechanical Analysis of Extracted Aggregate
Rotational Viscosity	Sieve Analysis of Mineral Filler	Bulk Specific Gravity of Compacted Specimens
Rolling Thin Film Oven Test and Mass Loss	Specific Gravity and Absorption of Fine Aggregate	Maximum Theoretical Specific Gravity
Pressure Aging Vessel	Specific Gravity and Absorption of Coarse Aggregate	Marshall Stability and Flow
Bending Beam Rheometer	Moisture Content	Superpave Gyratory Compaction

The American Association for Laboratory Accreditation (AALA) currently accredits Fugro South for soils, concrete and asphalt materials testing. This process complies with the scope of accreditation detailed in the ISO/IEC Guide 25-1990. This accreditation is currently valid and is required on materials testing completed for the Texas Department of Transportation.

MACTEC

MACTEC-Laboratory and Testing Capabilities

MACTEC maintains the most complete asphalt, soil, and concrete accredited laboratory in the state of Arizona. Our Phoenix laboratory meets the requirement of ASTM E-329 and E-1884 specifications. Our lab is CCRL accredited for Portland Cement Concrete and Aggregates and is AASHTO (AMRL) accredited for Aggregate Hot Mix Asphalt, Asphalt Cement/Cutback Asphalt and Emulsified Asphalt. MACTEC has recently (April 2001) completed a full AMRL inspection for the addition of PG Asphalt Binders to these accreditations.

- Maintained by Mr. Sam Huddleston, MACTEC is equipped with a complete and separate asphalt and bituminous mixture laboratory possessing various capabilities for asphalt and asphalt rubber mix designs, asphalt recovery, emulsified asphalt and PG binder classification testing.

- MACTEC's Phoenix lab is the only independent Arizona facility with full "ISSA" Slurry Seal and Micro Seal design testing capabilities. The testing available includes wet track abrasion test, loaded wheel tester, cohesion tester and all other mix quality tests used in the slurry design process. MACTEC personnel are also fully proficient in field quality control using the above methods.

- Our concrete laboratory is equipped with a state of the art concrete software program, which was designed specifically for MACTEC by an outside software design company. The software program tracks concrete samples through receiving, curing, capping, testing, strength calculation and final report. This in-house software program allows us to present you with an accurate final report within hours of testing the concrete sample.

- As part of our in house quality control our asphalt, concrete, soil and aggregate laboratory undergoes an internal auditing program, which goes beyond AASHTO and CCRL certification guidelines. Our auditing program emphasizes our compliance with industry standards and engineering practice guidelines and focuses on client responsiveness and the quality of services we provide.

Laboratory Testing Highlights

- Asphalt Mix Design, including Superpave, Hveem, and Marshall Methods
- Asphalt-Rubber binder, blend designs and mix design testing. (MACTEC provided over 100 Asphalt-Rubber blend designs in the past year)
- Full "ISSA" Slurry & Micro Seal Testing Capabilities
- Skid Resistance Testing
- Specialty modified Asphalt binder testing including "Toughness and Tenacity"
- PG Asphalt Binder – Direct Tension Testing
- Crack Sealant and Marker Adhesive testing
- 600,000 lb compression machine for testing high strength concrete, specialty concrete products and a full line of prism testing
- 50% humidity chamber to cure shrinkage beams and other moisture controlled testing
- 60,000 lb compressive machine actuate to 1 lb, for mortar cube, soil, cement, concrete cores and other sensitive loading and strength testing
- Large 100% humidity moisture room for large capacity testing and storage
- Time of set testing equipment, routinely requested by cement and concrete suppliers, and performed by MACTEC lab technicians
- Petrographic examination equipment and in-house microscope for petrographic examination of concrete and aggregate samples

MACTEC's laboratory is well staffed with dedicated permanent lab (non-field) technicians. This assures accurate and timely turnaround of test results by technicians fully incorporated into the CCRL/AMRL accredited system. This includes 8 full-time technicians/engineers assigned to laboratory testing. Our lab is also set up with multiple suites of equipment for asphalt testing, this includes 2 permanent lab ignition ovens, 2 lab gyratory compactors, 3 lab Marshall hammers, 4 complete lab sets of sieves, and 2 complete sets of PG Binder test equipment.

APTECH

Our nation's transportation infrastructure represents an enormous investment; maintaining the value of this investment is the responsibility of many, including aviation authorities, public works departments, State highway agencies, and the Federal Government. A range of tools are required in this effort, ranging from computer technologies to advanced materials, from the application of new design principles to specialized testing techniques. And of course, agencies interested in keeping abreast of these changes require training for their staff. Applied Pavement Technology, Inc. (APTech) was formed in 1994 to provide the technical engineering assistance that these agencies need to do their job.

APTech offers a broad range of pavement engineering services. APTech's principals have backgrounds in pavement management technology; pavement design, maintenance, and rehabilitation; and technology transfer. APTech's staff have provided services to clients at the State, Federal, and local level, have worked with airport authorities, private industry, and consulting firms both in the United States and abroad, and are recognized leaders in their profession. Through teaming arrangements with other pavement-engineering firms and technical experts, APTech has the resources available to provide a full range of pavement engineering services to clients of any size.

APTech's certification as a Woman-Owned Business Enterprise (WBE) with several states, cities, and agencies nationwide will help satisfy any Disadvantaged Business Enterprise (DBE) requirements on federally funded projects.

APTech's Mission

APTech's mission is to apply its pavement engineering expertise to finding appropriate and effective solutions for agencies responsible for the design, maintenance, and rehabilitation of pavement facilities. In providing this expertise, it is APTech's objective to work together with its clients as a team, seeking practical solutions to solve clients' problems. We value our clients' input, respect their ideas, and are responsive to their needs. We strive to not only meet but also exceed our clients' expectations.

Our mission is accomplished through:

- The leadership of knowledgeable and experienced pavement engineers.
- Qualified and dedicated staff that share management's outlook.
- A working environment in which an emphasis is placed on both creativity and technical competence.

APTech's Offices

APTech provides specialized pavement engineering services out of its Chicago-area, Central Illinois, Vermont and Nevada offices. Each office is fully equipped with state-of-the-art technology, including personal computers, laser printers; fax machines, scanners, and other equipment.

- Training in maintenance treatments
- Field data collection experience
- Statistician]

CEL

Consolidated Engineering Laboratories maintains a complete asphalt, aggregate, and concrete accredited laboratory in California. The Oakland laboratory is inspected and certified by Caltrans annually. Our lab is CCRL certified for Portland Cement Concrete and is AASHTO (AMRL) accredited for Hot Mix Asphalt, Emulsified Asphalt and Aggregates. Consolidated Engineering Laboratories is one of a handful of materials testing and inspections firms across the United States to be certified under the International Standard Organization ISO 9001-2000.

Consolidated Engineering Laboratories' main laboratory in Oakland, California, has 14,000 square feet comprised of 4,000 square feet of office and engineering space and 10,000 square feet of laboratory space. It houses our:

- AASHTO accredited and CCRL inspected concrete laboratory
- AASHTO accredited hot mix and asphalt emulsion laboratory
- ISSA Slurry Seal and Microsurfacing Mix Design resources
- ANST certified non-destructive tests
- Full-service machine shop for machining test specimens to required ASTM standards
- 50% humidity room to cure shrinkage beams and other moisture controlled testing
- 100°C plus heating room for heat-controlled environment conditions during testing
- Large 100% humidity moisture room for large capacity testing and storage
- 600,000 lb and 60,000 lb compression testing machines
- Hot Mix Asphalt Mix Design resources
- Humidity-controlled drying oven for Sprayed-on Fireproofing
- CEL Consulting group consisting of eight people who perform a wide variety of specialized engineering functions: forensic evaluations, failure analysis, product certification testing, pre-seismic evaluation and testing of models and existing structures, expertise witnessing

Consolidated Engineering Laboratories is well staffed with dedicated permanent lab technicians. This assures accurate and timely turnaround of test results by NICET (National Institute of Certified Technologies) certified and ACI certified technicians fully incorporated into the AMRL/CCRL accredited system. Our technicians participate in continuing education programs to enhance their capabilities and continual improvement program consistent with ISO 9001-2000 standards as we are consistently striving to increase the value of our service to the clientele and the industry we serve.

Section 6
Project Experience / References

PROJECT EXPERIENCE / REFERENCES

This section provides information on selected clients that Fugro-BRE has performed similar work to that proposed in this request.

FIRM NAME:	**FHWA**
Contact Name:	Aramis Lopez
Street address:	Turner Fairbanks Highway Research Center 6300 Georgetown Pike F-209
City, State, Zip:	McLean, VA 22101-2767
Telephone Number:	202-493-3145

Brief description of service: Fugro-BRE has served as the Southern Region Coordinator for 12 years on FHWA's LTPP Program: from 1988 to 1992 as part of Strategic Highway Research Program (SHRP); and from1993 to the present under the auspices of the FHWA. Principal activities under this contract include the following: data collection (distress, profile and deflection) on all GPS test sections and SPS projects in the southeastern US and Puerto Rico; quality control review and processing of the collected data; coordination of state-collected data (inventory, traffic and maintenance); and coordination with the FHWA to ensure that program needs are met. In support of the LTPP program Fugro-BRE staff has worked with the FHWA and other contractors to assist with the development of test and data collection protocols. Fugro-BRE's service has consistently been rated "Excellent" by the client review panel.

Service Dates:	2001-2006
Service Value/Cost:	$2,000,000 per year for 5 years

FIRM NAME	**TEXAS DOT**
CONTACT NAME:	Steve Smith, PE
Street address:	Construction & Lab 3901 E Highway 80, Bldg 10
City, State, Zip	Odessa, TX 79761
Telephone Number:	915-332-0501

Brief description of service: Pavement surface distress data were collected and evaluated on the most severely distressed lane of each roadbed assigned for the Odessa District. Additionally, in this District geotechnical borings were taken and a GIS application was developed to facilitate integration of these data into the highway network information. Other data included in the GIS application were the following: pavement performance indicators, traffic volume, accident data and bridge sufficiency ratings.

Service Dates:	1995-Present
Service Value/Cost:	$300,000

FIRM NAME: **CITY OF AUSTIN, TEXAS**
Contact Name: Mr. Scott Lambert
Street address: 206 E. 9th Street
Two Commodore Plaza, Suite 15-120
City, State, Zip: Austin, TX 78701
Telephone Number: 512-440-8444

Brief description of service: Over 2050 miles of existing roadways throughout the city of Austin were visually surveyed. Additionally, new construction was evaluated using a KJ Law profiler to determine the pavement ride quality in terms of the industry standard, i.e., IRI (International Roughness Index). The pavement evaluation data have been used in life cycle cost analyses to assess alternative maintenance and rehabilitation strategies.

Service Dates: November 1999 – November 2001
Service Value/Cost: $116,000

This section includes information on selected clients for CEL.

FIRM NAME: **VALLEY SLURRY SEAL**
Contact Name: Jeff Reed
Street address: PO Box 1620
City, State, Zip: West Sacramento, CA 95691
Telephone Number: 916-373-1500
Brief description of service: CEL provided slurry seal and micro-surfacing mix designs on numerous aggregate sources in California and internationally. CEL provides Quality Control testing of its materials supplied to agency projects.
Service Dates: May 2001 - Present
Service Value/Cost: $30,000 annually

FIRM NAME: **CITY OF FREMONT – DEPARTMENT OF PUBLIC WORKS**
Contact Name: Michael Christianson
Street address: PO Box 5006
City, State, Zip: Fremont, CA 94537
Telephone Number: 510-13-5719
Brief description of service: CEL provides Quality Assurance testing for the city's slurry seal and cape seal applications. Consolidated assists the city's inspectors with on-site project assessment and inspections.
Service Dates: June 2002 - Present
Service Value/Cost: $15,000

This section provides information on selected clients for which APTech has performed similar work to that is proposed in this request.

FIRM NAME **NCDOT**
Contact Name: Steve Varnedoe
Street address: PO Box 25201
City, State, Zip Raleigh, NC 27611
Telephone Number: 919-715-5662

Brief description of service: APTech has provided 12 training courses to the NCDOT over the past 2 years under the direction of Mr. Varnedoe. He is very familiar with APTech's ability to develop, present, and customize maintenance training to his staff.
Service Dates: 2001/2002
Service Value/Cost: $100,000

FIRM NAME: **NCHRP TRANSPORTATION RESEARCH BOARD**
Contact Name: Dr. Amir N. Hanna
Street address: 500 Fifth Street NW
City, State, Zip: Washington, DC 20001
Telephone Number:
Brief description of service: The objective of this research is to develop a methodology for determining the optimal timing for the application of preventive maintenance treatments to flexible and rigid pavements. The project also includes the development of a user-friendly tool to facilitate use and implementation of this methodology for the variety of pavement maintenance situations encountered by highway agencies. Work with five state highway agencies will demonstrate the applicability of the methodology and the suitability of the implementation tool. The project team is also developing a plan, for use by highway agencies, to collect the data needed to support the proposed methodology.

Service Dates: 4/00 – 1/03
Service Value/Cost: $293,296

This section provides information on one client that MACTEC has performed similar work to that proposed in this request.

FIRM NAME: **CALIFORNIA DOT**
Contact Name: Terrie Bressette
Street address: 5900 Folsom Blvd.
City, State, Zip: Sacramento, CA 95819
Telephone Number: 916-227-7303
Brief description of service: MACTEC (formerly LAW-Crandall) is currently under contract with Caltrans to provide on-call consulting services in all aspects of Flexible Pavements. This includes tasks on maintenance treatments, laboratory testing, and modified binders.

Service Dates: 10/01 – 9/04
Service Value/Cost: **$7,000,000**

Training

Tables 6.1 and 6.2 summarize training courses developed/delivered by the project team.

Table 6.1 Summary experience of Fugro-BRE in developing and presenting National Highway Institute (NHI) training courses.

NATIONAL HIGHWAY INSTITUTE PAVEMENT TECHNOLOGY TRAINING PROGRAM AND HIGHWAY CONSTRUCTION AND MAINTENANCE TRAINING PROGRAM	
NHI Course No.	Title
NHI 13123	"Highway Materials Engineering, Module V: Asphalt Materials and Paving Mixtures" Course Development/Delivery, Subcontractor to Arizona State University. Completed 1994. (BR91-02)
NHI 13442	"Materials Control and Acceptance—Quality Assurance" Course Development/Delivery, 5-Day and 2-Day (Demonstration Project 89) Versions. Completed 1994. (FH9)
NHI 13442	'Validation in Quality Assurance' Develop/Deliver 1-Day Executive Module of "Materials Control and Acceptance—Quality Assurance" Course. Completed 1998. (3014)
NHI 13451 NHI 13452 NHI 13453	'Analysis and Interpretation of Statistical Test Results, Hot Mix Asphalt' 'Analysis and Interpretation of Statistical Test Results, Portland Cement Concrete' 'Analysis and Interpretation of Statistical Test Results, Aggregates' NHI 13451, 13452, 13453: Develop Materials-Specific Statistics Modules for HMA, PCC, and Aggregates, for "Materials Control and Acceptance—Quality Assurance" Course. Closed 2002. (3053)
NHI 134042	"Materials Control and Acceptance—Quality Assurance" Deliver Updated Course. In-Progress through December 2002. (3113)
NHI 13145	"Hot Mix Asphalt Materials, Characteristics, and Control" Course Development. Completed 1999. (3008b)
NHI 13145	"Hot Mix Asphalt Materials, Characteristics, and Control" Course Deliveries. Completed 2002. (3047)
NHI 131045	"Hot Mix Asphalt Materials, Characteristics, and Control" Course Update. Completed 2002. (3112)
NHI 13164	"Introduction to Mechanistic Design for New and Rehabilitated Pavements" Course Development, Subcontractor to ERES Consultants. Completed 2001. (3060)
NHI 13132	"Hot Mix Asphalt Construction" Course Deliveries, Subcontractor to APTech. Completed 2001. (3072)
NHI 131100	"Pavement Smoothness/Roughness, Factors Affecting Inertial Profiler Measurement Used for Construction QC" Course Development. Completed 2002. (3094)
NHI 131100	"Pavement Smoothness/Roughness, Factors Affecting Inertial Profiler Measurements Used for Construction QC" Course Deliveries. In Progress through February 2005. (3125)

Table 6.2 Summary Experience of APTech Staff in Developing and Presenting NHI Training Courses

NHI Course No.	Title	Team Members Involved and Role(s)
13108	Techniques for Pavement Rehabilitation	Steve Seeds (Development/Instruction) David Peshkin (Development/Instruction) Scott Gibson (Instruction)
13128	AASHTO Design Procedures for New Pavements	David Peshkin (Development/Instruction)
13129	AASHTO Pavement Overlay Design	David Peshkin (Instruction)
131050	Asphalt Pavement Recycling Technologies	Steve Seeds (Development, Instruction) Scott Gibson (Pilot Instruction)
13130	Pavement Analysis and Design Checks	David Peshkin (Development/Instruction)
131032	Hot-Mix Asphalt Construction	Steve Seeds (Instruction) David Peshkin (Instruction) Scott Gibson (Pilot Instruction)
131054	Pavement Preservation: The Preventive Maintenance Concept	David Peshkin (Development/Instruction)
131058	Pavement Preservation: Selecting Pavements for Preventive Maintenance	David Peshkin (Development/Instruction) Scott Gibson (Instruction)
131062	PCC Pavement Evaluation and Rehabilitation	David Peshkin (Development/Pilot Instruction) Steve Seeds (Development/Instruction)
131063	HMA Pavement Evaluation and Rehabilitation	Steve Seeds (Development/ Instruction) David Peshkin (Development/Instruction) Scott Gibson (Instruction)

Section 7
Subcontractors

SUBCONTRACTORS

This section includes a brief description of the work to be done by each subcontractor. A detailed description of the companies was provided in Section 5, Facilities and Resources.

MACTEC (formerly LAW-Crandall)

MACTEC has a strong history of performing projects in the infrastructure are for all levels of government as well as private industry. Based out of Atlanta, GA, our size and technical expertise nationwide enable us to take on any size project, regardless of its size, location, or complexity. We have 118 office locations with nearly 4000 employees located throughout the United States. Office locations include many of the participating states in this pooled fund study (CA, GA, IL, NH, and NV). The company offers services related to the project in:

- Construction materials testing
- Construction engineering inspection
- Pavement evaluation and management
- Materials engineering

The services have been providing for projects including streets and highways; airports and port facilities. For this study, MACTEC will provide technical services in all 3 phases and will provide the services of their Phoenix lab in phase 2.

APTech

APTech has an extensive background in preventive maintenance treatments, training on maintenance treatments, and field evaluation of projects. Their role in this project is to assist primarily in phases 1 and 3.

CEL

Consolidated Engineering Laboratories will be the site for the majority of testing under Phase 2. Current slurry seal and microsurfacing mix design methods will be employed during Phase 2, as well as the new/revised test methods. Sample preparation for off-site testing at MACTEC and FUGRO-BRE will be maintained at CEL. Test methods for Quality Control and Quality Assurance testing and inspection will be developed in our Oakland facility. Laboratory mix designs and validation testing for the pilot projects will be performed by Consolidated.

Section 8
Text References

TEXT REFERENCES

1. A Basic Asphalt Emulsion Manual, Manual Series No. 19, Third Edition, Asphalt Emulsion Manufactures Association, Annapolis, MD

2. ASTM D-977, Specification for Emulsified Asphalt and D-2397, Specification for Cationic Emulsified Asphalt, American Society of Testing and Materials International, Volume 04.03, ASTM International, West Conshohocken, PA, 19428, 2002

3. Distress Identification Manuals of the Long-Term Pavement Performance Project, Report SHRP-P-338, Strategic Highway Research Program, National Research Council, Washington, DC, 1993

4. Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal, A 105, International Slurry Surfacing Association, Annapolis, MD

5. Recommended Performance Guidelines for Micro-Surfacing, A 143, International Slurry Surfacing Association, Annapolis, MD

6. Hicks, R.G., S.B. Seeds, and D.G. Peshkin. “Selecting a Preventive Maintenance Treatment for Flexible Pavements,” US Department of Transportation, Federal Highway Administration, Washington, DC, August 2000.

7. Peshkin, D.G., et al, “Pavement Preservation: The Preventive Maintenance Concept,” Course No. 131054, National Highway Institute, Federal Highway Administration, Washington, D.C., September 1999.

8. Peshkin, D.G., et al, “Pavement Preservation: Selecting Pavements for Preventive Maintenance,” Course No. 131058, National Highway Institute, Federal Highway Administration, Washington, D.C., September 2001.

9. State of the Practice-Design, Construction, and Performance of Micro-surfacing, US Department of Transportation, Federal Highway Administration, Washington, DC February, 1994

10. West, Kelly, et al, Micro-surfacing, Guidelines for Use and Quality Assurance, Texas Transportation Institute, Texas A&M University, College Station, TX, August 1996.

11. Micro surfacing (Quality Control), A Guide to Quality Construction, International Slurry Surfacing Association, Annapolis, MD.

12. Hein, David K., et al, Design, Construction and Performance of Micro-Surfacing for Urban Pavements, presented at the 73rd Annual Transportation Research Board meeting, Washington, DC, January 1994.

13. Smith, Roger E, et al, Use of Micro-surfacing in Highway Pavements, Research Report 1289-2F, Texas Transportation Institute, Texas A&M University, College Station, TX, August, 1994.

14. Andrews, Edward M, et al, The Evaluation of Micro-surfacing Mixture Design Procedures and the Effects of Material Variation on the Test Responses, Research Report 1289-1, Texas Transportation Institute, College Station, TX, August, 1994.

15. Design Technical Bulletins, International Slurry Surfacing Association, Annapolis, MD, 1990.

16. ASTM Standards on Precision and Bias for Various Applications, Fifth Edition, 1997, Publication Code Number 03-511097-34, ASTM, 100 Barr Harbor Drive, West Conshohocken, PA, 19428

Section 9
Appendices

APPENDIX A
Resumes

JAMES S. MOULTHROP, P.E.
Senior Project Manager

Education

B.A. Geology, St. Joseph's College, 1960
M.S. Geology, Kansas State University, 1963

PROFESSIONAL REGISTRATION

Professional Engineer – Pennsylvania (No. 014015-E)

Fugro-BRE, Inc.
8613 Cross Park Drive
Austin, Texas 78754

Phone: (512) 977-1800
Fax: (512) 973-9565
E-mail:jmoulthrop@fugro.com

Representative Experience

Prior to joining Fugro-BRE, Inc., Jim Moulthrop was a Pavement System Manager with Koch Pavement Solutions in the South Region office in Austin, TX. He served in that capacity from July 1998 to September 2002 From 1993 to 1998, he was president of Moulthrop Technologies, Inc., a firm specializing in technology advancements in pavement maintenance, quality control/quality assurance, and pavement materials. In 1993Mr. Moulthrop and Dr. Thomas Kennedy co-founded Asphalt Research and Development International (ARDI), a consulting engineering firm located in Austin, Texas. ARDI specialized in the evaluation of new products and technology for the asphalt paving industry, as well as training and general problem solving. Mr. Moulthrop served as a staff member of the Department of Civil Engineering at the University of Texas at Austin, where he was a Research Engineer for the Center for Transportation Research from 1987 to 1993. In this position, he served as Technical Program Director for the Strategic Highway Research Program (SHRP) Asphalt Technical Assistance Contract (A-001), which was awarded to the University in October 1987.

Mr. Moulthrop has an extensive career in the transportation field, with an emphasis in asphalt technology, having worked with Exxon Chemical Americas, Lubrizol Corporation, and the Pennsylvania Department of Transportation. Mr. Moulthrop worked for twenty years with the Pennsylvania Department of Transportation in various assignments, including District and Regional Soils Engineer, Chief Field Materials Control Engineer, Chief of the Materials and Testing Division, and Director of Hghway Maintenance. He subsequently spent five years in product development, technical marketing, and the application of asphalt modifiers with Lubrizol Corporation and Exxon Chemical Americas before joining the research staff of the University of Texas at Austin. Mr. Moulthrop is a registered professional engineer in Pennsylvania and is currently serving on several Transportation Research Board Committees; is Section Chair of the Bituminous Committee, A2D00; is Vice Chairman of ASTM D-4, Road and Paving Materials Committee; and has recently been elected as a Member of the Board of Directors of the Society for a three-year term. In addition, he is a member of the Association of Asphalt Paving Technologists, having served as Chairman of the 1988 Nominating Committee and as a member of the 1995 Nominating Committee. He is also a member of the Board of Directors of the Foundation for Pavement Preservation; Chair of the FHWA Pavement Preservation Performance Related Specification Expert Task Group; and a member of the FHWA Expert Task Group on Pavement Preservation. Mr. Moulthrop is also an ad-hoc member of .the AASHTO Subcommittee on Maintenance, Pavement Preservation Task Group. He recently served on the TRB/FHWA Working Group as a member of the Infrastructure Renewal Task Force. He was a member of the Steering Committee for the Fifth International Conference on Managing Pavements, held in Seattle, Washington, in August 2002 and is serving on the Technical Advisory Group for the International Society of Asphalt Pavements Conference in Copenhagen, August 2002.

Mr. Moulthrop is a recognized international leader in pavement preservation and asphalt technology. Some of his accomplishments include:

- Was a team member of the US lead Pavement Preservation Scanning Tour of France, South Africa, and Australia sponsored by FHWA and AASHTO.
- Served as the program leader in instituting and promoting the introduction and use of new pavement preservation systems [Novachip and Strata] for Koch Pavement Solutions in the eight southern region states.
- Has served as Technical Director for the largest asphalt research program ever conducted.
- His prime responsibilities with Exxon Chemical Americas were the business planning associated with the implementation of a new family of asphalt modifiers to enhance pavement performance and the application of various types of asphalt mixtures throughout the United States using Polybilt™ polymers.
- As Eastern Regional Director for asphalt modification for Lubrizol Corporation, he was responsible for a variety of activities including business planning; budgets; interfacing with State DOTS; coordination with FHWA in Washington, DC; and the successful application of modified pavements in West Virginia, Ohio, and Kentucky.
- While Director of Highway Maintenance for Penn DOT, he was responsible for a 485 million dollar budget. In addition, he chaired the Roadway Management System Implementation Committee, which established the foundation for Penn DOT's pavement management system.
- While Field Materials Engineer for Penn DOT, he directed the implementation of the Restricted Performance Specification for asphalt concrete pavements. It has been estimated by Penn DOT personnel that this specification has been responsible for a 20% increase in pavement life.
- While a Soils Engineer with Penn DOT, he had the lead responsibility in the construction of a large 0.5 mile long earth embankment over a deep swamp on Interstate 80, the subsurface investigation on Interstate 79 for a 1.0 mile pile supported viaduct over the Conneaut Marsh in North West Pennsylvania, and crisis management to support a 96 inch water line which was affected by a cut slope slide on State Route 56 near Johnstown, Pennsylvania.

Professional Affiliations

- Transportation Research Board, Committees A2D03, A3C01, A3C05, A2D04, A2F03, A2D00
- American So00ciety of Highway Engineers, Harrisburg, Pennsylvania chapter
- American Society of Testing and Materials, Vice Chairman of D04
- Association of Asphalt Paving Technologists
- Foundation for Pavement Preservation, Board of Directors
- Canadian Technical Asphalt Association

Publications

Manuals

Strategic Highway Research Program. Asphalt Research Program Report A-410. Superior Performing Asphalt Pavements (Superpave®): The Product of the SHRP Asphalt Research Program. National Research Council. Washington, D.C. 1994. Co-Author.

Materials Control and Acceptance - Quality Management. Federal Highway Administration Contract DTFH61-92-C-00097 with Brent Rauhut Engineering, Inc., Austin, TX, December 1992. Contributing Author.

Quality Management of Highway Materials and Construction Using Restricted Performance Specifications. Nittany Engineers and Management Consultants, Inc. State College, PA Oct. 1989. Contributing Author.

Practical Applications of Statistical Quality Control in Highway Construction. U. S. Department of Transportation, Federal Highway Administration Course Notebook. The Sigma Partnership, 1979. Contributing Author.

"Statistical Quality Control of Highway Construction in Pennsylvania," 650 pages. Contributing authors: Willenbrock, J. H.; Nicotera, R.; Cominsky, R.; Moulthrop, J.; and, Marcin, J. 1975.

"Material Quality Assurance Manual," Pennsylvania Department of Transportation Publication No. 25. May 1974. Contributing Author.

<u>Journals, Periodicals, Proceedings</u>

“The Foundation for Pavement Preservation” with Dr. R. Gary Hicks and W.R. Ballou, Conference Proceedings the World Emulsion Congress, Leon, France, 2002.

“Preventive Maintenance versus Reconstruction: Life Cycle Cost Analysis of Various Options”, Todd V. Scholz, Dr. R. Gary Hicks and James S. Moulthrop, Ninth International Conference on Asphalt Pavements, Copenhagen, Denmark, August, 2002.

“Pavement Maintenance: Preparing for the 21st Century”, with Dr. R. Gary Hicks, Conference Proceedings 23, Proceedings of the Ninth Maintenance Management Conference, Juneau, Alaska, July 2000, National Academy Press, Washington, DC 20001.

“Pavement Preservation Issues for General Aviation Airports”, with Dr. R. Gary Hicks, Conference on Revolution in General Aviation. Corvallis OR, June, 2000.

“Performance of Thin and Ultra thin Hot Mix Asphalt overlays in the US”, with Dr. R. Gary Hicks, Australian Asphalt Pavement Association annual meeting, Sydney, Australia, February, 2000.

“Selecting a Preventive Maintenance Treatment for Flexible Pavements”, Proceedings of the CA Chip Seal Association, Sacramento, CA, January 1998.

“Unique Pavement Maintenance and Restoration Techniques Using Microsurfacing”, La Force, R., Moulthrop, J., Atherton, C. ISSA World Congress Proceedings, Paris, France, March, 1997.

“Framework for Selecting Effective Preventive Maintenance Treatments for Flexible Pavements”, with Dr. R. Gary Hicks and Kimberly Dunn, Transportation Research Board, National Research Council, Washington, D.C., 1997

"Overview of Emulsion Practices in the United States", with Dr. R. Gary Hicks and W.R. Ballou, Proceedings of the International Symposium on Asphalt Emulsions Technology. Washington, DC, October 1996.

"Microsurfacing". Proceedings of the Research-to-Practice Symposium on Repair and Rehabilitation of Bridges and Pavements. Warwick, RI, May, 1996.

"Aspects and Considerations for Specifications Containing Warranty Specifications". Proceedings of the Association of Asphalt Paving Technologists. Baltimore, MD, March, 1996

"Emulsions for Pavement Maintenance with an Emphasis on Slurry and Microsurfacing Systems". Proceedings of the ISSA Annual Meeting, Phoenix, AZ, February 1996.

"Initial Improvement in Ride Quality of a Jointed, Plain Concrete Pavement (JPCP) with Microsurfacing: A Case Study. Transportation Research Board. National Research Council. Washington, DC. January 1996.

"The Understanding of Binder-Aggregate Adhesion and Resistance to Stripping", Journal of the Institution of Highways and Transportation, London, England, October, 1992

"The SHRP Asphalt Research Program: Objectives, Organization, Strategies, and Products". The Institute of Asphalt Technology Seminar Papers, Dublin, Ireland, August 1992

"SHRP Results on Binder-Aggregate Adhesion and Resistance to Stripping", Eurobitume, May 1992.

"Strategic Highway Research Program: A Performance-Based Mixture Specification", Proceedings of the Australian Asphalt Pavement Association Conference, Sydney, Australia, November 1991.

"Strategic Highway Research Program-An Overview", with R.J. Cominsky, Thomas W. Kennedy, and Edward T. Harrigan, Association of Asphalt Paving Technologists, Seattle, WA, March 1991

"Strategic Highway Research Program-Overview and Status" Proceedings of the Thirteenth Annual FAA Airport Conference, Hershey, PA., March, 1990.

"Asphalt Cement Specifications and HMA Performance", Proceedings of the first Materials Engineering Congress, Volume 1, American Society of Civil Engineers, New York, NY, August, 1990.

"Materials Reference Library Asphalt Selection Process", SHRP-A/IR-89-002. Contributing authors: Cominsky, R.J.; Moulthrop, J.S.; Elmore, W.E.; Kennedy, T.W. August 1989.

"Experimental Design Guidelines for Asphalt Research Contractors", SHRP-A-WP-89-001. Contributing authors: Antle, C.E.; Rosenberger, J.L.; Moser, B.K.; Anderson, D.A.; Moulthrop, J.S.; Cominsky, R.J; Kennedy, T.W. August 1989.

"SHRP Update," The Asphalt Contractor Paving America. Contributing authors: Kennedy, T.W.; Cominsky, R.J.; Moulthrop, J.S. September-October, 1988.

"SHRP Asphalt Program Update" Proceedings of the 7th International Conference of the Australian Asphalt Pavement Association, Brisbane, Australia, August, 1988.

"Properties of Modified Asphalt-Aggregate Mixtures Involving a Metal Complex Catalyst". Proceedings of the 30th Annual Conference of Canadian Technical Asphalt Association, Moncton, New Brunswick, November 1985.

"Manganese Modified Asphalt Pavements--A Status Report." Transportation Research Record 1034, "Asphalt Materials, Mixes, Construction and Quality." Transportation Research Board, National Research Council, Washington, D.C., 1985, Co-author.

"Asphalt Emulsions for Highway Construction--Pennsylvania's Experience." Proceedings of the Ninth Annual Meeting of the Asphalt Emulsion Manufacturers Association, Las Vegas, Nevada, March 16-19, 1982.

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Pavement Preservation: Decision Trees. 34th Mid-Atlantic Quality Assurance Workshop, Washington, DC, February 2001

Thin Maintenance Overlays, 76th Annual meeting, Northeastern States Materials Engineers meeting, Portland, ME, October 2000.

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"SHRP Program Update". Shell Asphalt Seminar, Houston, TX, March 1992.

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"SHRP Program Update". Lubrizol Business Development Company, Cleveland, OH, July 1991.

"SHRP Program Update". Triaxial Institute Annual Meeting, Klamath Falls, OR, April 1991.

"SHRP Asphalt Specifications and Mixture Tests". Nevada Street and Highway Conference, Las Vegas, NV, April 1991.

"Contractor Role In The SHRP Asphalt Research Program". Oklahoma Asphalt Pavement Association Annual Paving Conference, Oklahoma City, OK, April, 1991

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"Strategic Highway Research Program Asphalt Research -- An Overview". US CRREL Meeting, Manchester, NH, February 1991.

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"Challenge to the Industry: Part 1, Quality Control", Vulcan Asphalt Mix Seminar, Atlanta, GA, June 1990.

"SHRP Program Update". FAA Airport Conference, Hershey, PA, March 1990.

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"Progress in SHRP Asphalt Research". Annual Bituminous Conference, Minnesota Association of Asphalt Paving Technologists, St. Paul, Minnesota, November, 1988.

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"Certification of Inspectors, Technicians, and Laboratories". Texas Hot Mix Asphalt Pavement Association Annual Meeting, Kerrville, Texas, September 1988.

"PennDOT's Approach to Quality Assurance". Maryland Asphalt Paving Conference, College Park, Maryland, March, 1977.

"Pennsylvania's Experience with the Design and Performance of Open Graded Asphalt Friction Courses". Pennsylvania Asphalt Pavement Association Winter Meeting, Pittsburgh, Pennsylvania, December 1976.

"PennDOT's Approach to Quality Assurance". Contractors Association of Western Pennsylvania, Oakmont, Pennsylvania, May 1976.

"Developments with PennDOT's Restricted Performance Specification for Portland Cement Concrete". Pennsylvania Ready-Mixed Concrete Association Summer Meeting, Clarion, Pennsylvania, July 1975.

"PennDOT's Approach to Quality Assurance". Pennsylvania Ready Mixed Concrete Association Summer Meeting, Buck Hill Falls, Pennsylvania, July, 1974.

"Directions with PennDOT". Pennsylvania Ready Mixed Concrete Association Summer Meeting, Seven Springs, Pennsylvania, July, 1973.

Teaching Experience

Materials Control and Acceptance. FHWA Demonstration Project 89 and NHI Course No. 13442. Instructor for twenty one courses from March 1993 to 1997.

Quality Management of Highway Materials and Construction Using Restricted Performance Specifications. Instructor for five courses taught for PennDOT in 1990 and 1991.

Practical Applications of Statistical Quality Control in Highway Construction. Five courses taught throughout the US 1979-80 for NHI.

Penn DOT's Restricted Performance Specification for Portland Cement Concrete. Implementation Training. Eleven sessions at Penn DOT district offices, Spring, 1976.

Penn DOT's Restricted Performance Specification for Bituminous Concrete. Implementation Training. Eleven sessions at Penn DOT district offices, Spring, 1975.

Quality Control for Concrete Technicians. Four courses for Industry concrete technicians sponsored by Penn DOT, Associated Pennsylvania Constructors and Pennsylvania Ready-Mixed Concrete Association. February, 1976-February, 1977.

Statistical Process Control Related to Penn DOT Restricted Performance Specifications:

Four courses to Pennsylvania Material Producers Committee in various areas of Pennsylvania, February, 1976 - February, 1977.

Two courses to Interstate Amiesite Corp., February 1976 - February, 1977.

Statistical Quality Control of Highway Construction in Pennsylvania. Twelve courses at the Pennsylvania State University. February 1974 - May, 1975.

AWARDS

- 1975 National University Extension Association (N.U.E.A.) "Creativity Award" for a series of twelve Continuing Education courses entitled "Statistical Quality Control of Highway Construction"

GLYNN HOLLERAN

Project Manager

G&J Holleran Consulting Services
170 Bald Eagle Drive
Vacaville California 95688

Phone 707 449 0375
Fax 707 449 3815
ghaustr@aol.com

Education:
B. Applied Science University Of Melbourne – Industrial Chemistry 1975
M. Applied Science University of Melbourne – Polymer Rheology 1977

Professional Memberships:

American Chemical Society
Royal Australian Chemical Society
Association Of Asphalt Paving Technologists

Representative Slurry Surfacing Experience:

Member D04 ASTM committee on Paving Materials
Former Asphalt Emulsion Manufacturers Association International Technical Committee member and Subcommittee Chairman on Paving (1985-2001)
Former International Slurry Surfacing Association Technical Committee Member (1987-2001)
Former Chairman Australian Asphalt Paving Association Federal Technical Committee (1992-1995)
Member of Australian Standards Committees on Paving Materials and Hot Mix. (1985-1995).
Member Australian Asphalt Pavement Association/ Austroads Research and Development Committee

Glynn Holleran until recently was senior advisor to California Department of Transportation METS working under a contract with Law Crandall (now MACTEC) from September 24 2001 to November 8 2002. In this capacity he advised the Maintenance group on surface treatments, carried out a survey of Caltrans pilot projects on microsurfacing and wrote a "Technical Advisory" for the use of surface treatments in Caltrans Maintenance. In this period he also designed and supervised a large microsurfacing project introducing this technology into the Federal Highways Administration in Northern Russia.

Prior to joining Law Crandall Mr. Holleran was Vice President for Technology and International Operations for Valley Slurry Seal Company from September 1995 to September 2001. His duties included technology transfer and equipment/project development in the areas of asphalt emulsions, slurry seal and slurry surfacing and modified binders. This included raw materials assessment (asphalt and aggregates), emulsion and binder formulation, mix design (especially in relation to local raw materials, and climate), equipment recommendations and commissioning and field application. In many projects he carried out laboratory set up and training. He successfully carried out projects in Romania, China, Russia, Saipan, Japan, Korea, Malaysia, Austria, New Zealand, Thailand, and Saudi Arabia. Other duties included presenting seminars and papers on maintenance treatments and raw materials chemistry and design in the above places and also Cambodia, Singapore, UK, France, Germany and, Australia. Was invited to present a daylong seminar on Microsurfacing for the Chinese Government Research Center for Roads in 1999.

Mr. Holleran was " Group Technical Manager" for Mobil Oil's bituminous products group from January 1985- September 1995. Directed the laboratory and provided technical service for polymer modified binders, hot mix, cold mix, emulsions, foamed bitumen, chip sealing and hot mix operations, slurry surfacing operations. He was instrumental in the introduction of microsurfacing into Australia and reintroduction of slurry seal. Member of "Austroads" industry DOT committees on design of slurry surfacing and on bitumen emulsions 1986-2001. Responsible for all bitumen emulsion, polymer modified binder and slurry designs. Carried out slurry surfacing, polymer modified binder and emulsion projects for Mobil in Eritrea, South Africa and Australia. Worked with raw materials from different laces and several different microsurfacing systems including Ralumac, Colas and Akzo Nobel. Developed a new microsurfacing system using Australian raw materials and new chemicals. He was the first to introduce synthetic latex modification to road emulsions in Australia (1986).

1992-1995- Bitumen Chemistry- controlled bitumen refinery formulations and crudes for the Mobil bitumen production in Australia. Carried out project on bitumen chemistry and control 1991-1993 which changed Mobil refining methodology.1990-1995 served as consultant to Marketing Refining Department International of Mobil Corporation USA on bituminous products. Instituted bitumen (asphalt) manufacture at Paulsboro refinery 1995.

Prior to 1985 Mr. Holleran worked in the polymer industry with ICI Australia (1977-1982) as Research Officer and in adhesives and polymer latex with Roberts Australia Ltd as Chief Chemist (1982-1985).

Currently Mr. Holleran conducts a private business in consulting with clients in Jamaica, Australia, USA, Russia and China.

CAROL GOLDMAN

Co-Project Manager

Consolidated Engineering Laboratories, Inc.
534 23rd Avenue
Oakland, California 94606

Phone (510) 436-7626
Fax (510) 436-7699
cg@ce-labs.com

Experience

May 2001 – Present
Laboratory Manager , Soils/Asphalt/Emulsions
Consolidated Engineering Laboratories, Oakland, California

Responsible for managing laboratory services for testing soils, aggregate, hot mix asphalt, and emulsion. Providing technical support—materials analysis, specification review/writing, quality assurance, and quality control—to agencies, contractors, and engineers. Responsible for marketing of emulsion application projects—customer contact, project initiation, and project management. Maintain involvement in Foundation for Pavement Preservation (FHWA), and ISSA (International Slurry Surfacing Association

January 2000 – May 2001
Technical & Marketing Manager
Reed & Graham Laboratory Services, San Jose, California

Responsible for providing technical support and services in asphalt emulsion materials and applications. Continue to provide project management, in-house training, laboratory testing and reporting of results. Maintain involvement in ISSA (International Slurry Surfacing Association), AEMA (Asphalt Emulsion Manufacturer's Association), and MSA (Maintenance Superintendents Association).

June 1995 – December 1999
Asphalt Emulsions Laboratory Manager
Reed & Graham Laboratory Services, San Jose, California

Responsible for the provision of field and laboratory services for emulsions, slurry seal, chip seal, and micro-surfacing. Work involved management of all activities concerning customers' projects, personnel training, equipment calibration, quality assurance, and quality control, testing and reporting. Provided technical support to agencies, contractors, and engineers. Responsible for maintaining the laboratory accreditation by AASHTO Materials Reference Laboratory. Participate in ISSA, AEMA, and MSA.

June 1992 – June 1995
Laboratory Director
Terratech, Inc., San Jose, California

After one year as the Laboratory Manager for Terratech's main office in San Jose, became responsible for corporate operations of Terratech's three laboratories and mobile laboratory services. Responsible for maintaining the laboratory accreditation by AASHTO for asphalt concrete, aggregates and geotechnical soils.

1987 – 1992
Laboratory Manager
Signet Testing Laboratories, Hayward, California

Responsible for laboratory testing and coordinating staff to complete aggregate, soils, and hot mix asphalt testing. Responsible for reporting test results to clients. Responsible for performing training staff to test in accord with ASTM, AASHTO, and Caltrans specifications.

1983 – 1986
Laboratory and Field Technician
Signet Testing Laboratories, Hayward, California

Performed laboratory tests and field inspections of hot mix asphalt, slurry seal, aggregates, and soils.

PUBLICATIONS
"Lab Examines Quality Side of Maintenance", Asphalt Contractor, July 1999.

PRESENTATIONS
"Hand Mixes and Laboratory Equipment", ISSA Slurry Systems Workshop in Austin, Orlando, Las Vegas, February 1997 – 2002.

"Laboratory Presentation of Slurry Seal Mix Design", CCSA Western Pavement Maintenance Forum, Sacramento, January 1998.

"QC/QA of Chip Seals", MSA Equipment Show, Concord, September 1997.

"QC/QA: A Laboratory Perspective", CCSA Western Pavement Maintenance Forum, Ontario, January 1997.

"Quality Assurance/ Quality Control: A Laboratory Perspective", AEMA Symposium, Washington, D.C., October 1996.

ASSOCIATION MEMBERSHIP
ISSA: International Slurry Surfacing Association

CERTIFICATIONS
NICET (National Institute of Certified Engineering Technology), Level III, Highway Materials

David G. Peshkin, PE

Vice President
Applied Pavement Technology, Inc.

EDUCATION

M.S., Civil Engineering, University of Illinois, 1987
B.S., Civil Engineering, University of Illinois, 1986
B.A., History, Swarthmore College, 1977

PROFESSIONAL REGISTRATION

Professional Engineer, Illinois, Vermont, and New York

PROFESSIONAL AFFILIATIONS

Member, American Society of Civil Engineers
Member, Transportation Research Board Committee A3C05, *Pavement Maintenance*

PROFESSIONAL SUMMARY

Mr. Peshkin joined Applied Pavement Technology, Inc. (APTech) in 1996 as a Vice President and Principal of the firm. Since joining APTech, Mr. Peshkin has focused his technical efforts on airfield pavement evaluation and design projects, technology transfer for pavement design, maintenance, and rehabilitation, and pavement research. He has been the Project Manager on the development of a new training course for the Federal Highway Administration (FHWA) through its National Highway Institute (NHI) titled *Pavement Preservation: The Preventive Maintenance Concept* and is developing a second course, *Pavement Preservation: Selecting Pavements for Preventive Maintenance*. He also coordinates the scheduling of and teaches the NHI course, *Hot-Mix Asphalt Construction*. Mr. Peshkin is also an instructor for the FHWA/NHI workshop on design details for concrete pavements, and contributing author and instructor for two FHWA courses on pavement rehabilitation. Mr. Peshkin is an NHI-recognized Certified Instructor, and has assisted in the development and presentation of many successful training courses. At Chicago's airports, Mr. Peshkin has served as the Project Manager or Principal-in-Charge on APTech's pavement evaluation and design projects since 1996, including 4 runways, 5 taxiways, and numerous other projects. Elsewhere around the country, he has led evaluation and design projects both as a Project Manager and as a subcontractor to other firms.

In April 2000, APTech was awarded NCHRP Project 14-14, *Optimal Timing of Preventive Maintenance*, with Mr. Peshkin as Principal Investigator (PI). Mr. Peshkin also served as the PI on a project for the South Dakota Department of Transportation evaluating the methods currently used by the Department for the collection of roadway data and making recommendations for improving the current practices.

Prior to joining APTech, Mr. Peshkin spent one year working as a consultant in the pavement-engineering field. During that time, he developed presentation materials on pavement maintenance effectiveness for an FHWA project on innovative pavement materials, helped to develop guidelines for the design of rigid pavements, and assisted on a concrete pavement technology research effort. He served as an instructor for the NHI course *Hot Mix Asphalt Construction*, and presented the course seven times throughout the United States. Mr.

Peshkin also spent almost 7 months in Malaysia on an Asian Development Bank-funded project to revise the World Bank's models for flexible pavement performance. As Principal Researcher–Roads, he was responsible for overseeing the pavement model development; he also had research and authorship responsibilities for several key sections of the final product.

As an employee of ERES from 1986 to 1995, Mr. Peshkin contributed both technically as well as in a leadership role on numerous nationally acclaimed pavement research and training projects. His accomplishments at ERES include lead roles on many FHWA studies, such as *Performance/Rehabilitation of Rigid Pavements, Pavement Maintenance Effectiveness*, and *Concrete Pavement Technology*. He assisted in the development of the Navy's Design Manual for airfield pavements and the associated software. Mr. Peshkin served as the Project Manager for two projects for the Strategic Highway Research Program (SHRP), SHRP H-101 on Maintenance Effectiveness (under subcontract to TTI) and SHRP H-105, *Innovative Materials and Equipment for Pavement Surface Repairs*. He also was the Co-Principal Investigator for SHRP H-106, a 2.5-year study of the field performance of maintenance materials. He served as the Principal Investigator for a project for American Association of State Highway and Transportation Officials (AASHTO) to develop their pavement design software, DARWin, and oversaw the follow-up to that project. He also served as the Principal Investigator for the development and instruction of two training courses for the FHWA: AASHTO Design Procedures for New Pavements and Pavement Analysis and Design Checks.

Mr. Peshkin was honored with the 1986-87 Kent Award by the University of Illinois Department of Civil Engineering. In 1989, he received the second Eldon J. Yoder Outstanding Paper Award at the Fourth International Conference on Concrete Pavement Design and Rehabilitation (with co-authors K. Smith, M. Darter, and A. Mueller).

REPRESENTATIVE ENGINEERING EXPERIENCE

Pavement Research

- Principal Investigator for NCHRP Project 14-14, Guide for Optimal Timing of Pavement Preventive *Maintenance Treatment Applications*.
- Principal Investigator for the South Dakota Department of Transportation Project, *Review of SDDOT's Field Collected Roadway Data*.
- Principal Investigator for FHWA Project DTFH61-94-C-00023, *Pavement Maintenance Effectiveness/Innovative Materials*.
- Principal Investigator for FHWA Project DTFH61-94-C-00009, *Highway Concrete Technology—Development and Testing*.
- Co-Principal Investigator for SHRP Project H-106, *Innovative Materials Development and Testing*.
- Project Manager for an FHWA project DTFH61-90-C-00021, *Evaluation of Improved Cold Mix Binders*.
- Project Engineer for the FHWA research project, *Performance/Rehabilitation of Rigid Pavements*.
- Project Manager for SHRP project H-105, *Innovative Materials and Equipment for Pavement Surface Repairs*.
- Project Engineer on the Arizona DOT project, *Concrete Pavement Design and Rehabilitation*.

- Project Manager for a subcontract to Texas A&M on the SHRP Project H-101, *Maintenance Effectiveness*.

Training Courses And Manuals

- Developed and presented training sessions on airfield pavement maintenance to the Metropolitan Washington Airport Authority and the State of Hawaii.
- Principal Investigator/Instructor for the NHI training course, *Pavement Preservation: The Preventive Maintenance Concept*. Presented the course 13 times around the United States.
- Principal Investigator for the development of the NHI training course, *Pavement Preservation: Selecting Pavements for Preventive Maintenance*.
- Contributing author for the development of an NHI workshop on design details for concrete pavements; instructor for the course in Arizona, Utah, and California.
- Instructor for the NHI training course, *Hot Mix Asphalt Concrete Construction*. Since 1995, has led over a dozen course presentations around the US and in Puerto Rico.
- Principal Investigator/Instructor for the NHI training course, *Pavement Analysis and Design Checks*. Has led pilot presentations in North Carolina and Washington.
- Principal Investigator/Instructor for the NHI training course, *AASHTO Pavement Design Procedures*. Has led a pilot presentation in Missouri and taught the course in: Santiago, Chile; Texas (twice); Pennsylvania; Toronto; and Washington, D.C.
- Instructor for the NHI training course, *AASHTO Pavement Overlay Design*. Has taught the pilot course in Oklahoma and courses in Nevada and South Carolina.
- Project Manager and Principal Author for a project to revise and update the pavements portion of the Minnesota Department of Transportation pavement and geotechnical manual.
- Instructor for the National Highway Institute's course, *Pavement Design—Principles and Practices*. Has presented the course for state DOT's in Georgia, Nevada, Massachusetts, Wisconsin, Virginia, Idaho, Puerto Rico, and New York.
- Project Engineer on the project to revise the manual for the NHI course *Techniques for Pavement Rehabilitation*, National Highway Institute.
- Instructor for the NHI course *Techniques for Pavement Rehabilitation*. Has presented the course for over 20 state DOT's, the Virgin Islands, and Saudi Arabia.
- Project Engineer for the preparation of a handbook for the U.S. Navy, U.S. Navy MIL-HDBK-1021/2, General Policy for Airfield Pavement Design.
- Authored User's Guide for Version 3 of AASHTO's pavement design software, DARWin.

Computer Program Development

- Principal Investigator for the AASHTO project to create and revise the DARWin pavement design software (Versions 1 and 2).
- Project Engineer for the computerization of the U.S. Navy's rigid pavement design procedure.

AIRPORT EVALUATION, DESIGN, AND MANAGEMENT

- Project Manager on a subcontract providing construction support for runway rehabilitation at Amarillo International Airport.
- Principal-in-Charge for the evaluation and emergency rehabilitation design of NASA's Ames Research Center airside pavements at Moffett Field.

- Principal-in-Charge for the evaluation and rehabilitation design of Syracuse Hancock's Taxiway A and connectors.
- Project Manager for the pavement evaluation, rehabilitation design, and runway extension design at Palm Beach International Airport, Palm Beach, Florida.
- Project Manager for the pavement evaluation and design of rehabilitation for Runway 15–33 at Bangor International Airport, Bangor, Maine.
- Project Manager for the pavement evaluation of Runway 17R–35L at Lubbock International Airport, Lubbock, Texas.
- Project Manager for the pavement evaluation and design of rehabilitation for Runway 3–21, Wood County Airport, Parkersburg, West Virginia.
- Project Manager for the pavement evaluation and rehabilitation recommendations for Meigs Field, Chicago.
- Project Manager for the pavement evaluation and design of rehabilitation for Runway 4R, Midway Airport, Chicago.
- Project Manager for the following taxiway pavement evaluation and rehabilitation design projects at O'Hare International Airport: Taxiway M, Taxiway T, Taxiway S, Taxiway P, Taxiway W, and Taxiway F.
- Project Manager for the following runway pavement evaluation and rehabilitation design projects at O'Hare International Airport: Runway 4L, Runway 4R, Runway 9L, and Runway 14L.
- Project Engineer for the update of pavement management systems for O'Hare International Airport and Midway Airport.

SELECTED PUBLICATIONS

Selecting a Preventive Maintenance Treatment for Flexible Pavements, by R. Gary Hicks, S. Seeds, and D. Peshkin, Foundation for Pavement Preservation, January 2000.

Pavement Preservation: The Preventive Maintenance Concept, by D. Peshkin, K. Smith, K. Zimmerman, and D. Geoffroy. Federal Highway Administration, January 2000.

*Modeling Road Deterioration and Maintenance Effects in HDM-*4, by D. Peshkin, M. Riley, L. Kannemeyer, T. Van Dam, P. Cenek, and G. Rohde, Final Report, N.D. Lea International, 1995.

Pavement Management Guide for City Streets, by M. Broten, C. Beckemeyer, D. Peshkin, and K. Zimmerman, SDDOT Report No. SD92-10-G1, Project SD93-07, South Dakota Department of Transportation, 1994.

Pavement Condition Survey Guide for City Streets, by K. Zimmerman, C. Beckemeyer, and D. Peshkin, SDDOT Report No. SD92-10-G1, Project SD93-07, South Dakota Department of Transportation, 1994.

Pavement Design, Maintenance and Rehabilitation Guide for City Streets, by C. Beckemeyer, R. Kumapley, and D. Peshkin, SDDOT Report No. SD92-10-G1, South Dakota Department of Transportation, 1994.

The Construction and Performance of Concrete Pavements Reinforced with Flexarm, by D. Peshkin and M. Darter, Proceedings*,* 5th International Conference on Concrete Pavement Design and Performance, Purdue University, Indiana, 1993.

Cost-Effective Pavement Repair Materials, by D. Peshkin, Proceedings, Pacific Rim Transtech Conference, Seattle, Washington, 1993.

DARWin—AASHTO's New Pavement Design Program, by D. Peshkin, Proceedings, 8th Conference on Computing in Civil Engineering, ASCE, Dallas, Texas,1992.

Evaluation of Concrete Pavements Exhibiting Long-Term Performance, by D. Peshkin, K. Smith, and M. Darter, 19th World Road Congress, Marrakech, Morocco, 1991.

Performance of Concrete Pavements with Permeable Base Course, by K. Smith, D. Peshkin, and M. Darter, 19th World Road Congress, Marrakech, Morocco, 1991.

Field-Calibrated Mechanistic-Empirical Models for Jointed Concrete Pavements, by M. Darter, K. Smith, and D. Peshkin, Transportation Research Record 1307, Transportation Research Board, 1991.

Early Opening of New PCC Pavement and PCC Repairs to Traffic, by D. Peshkin, 1991 Compendium, 5th International Pavement Management/Maintenance Exposition and Conference, Cincinnati, Ohio, 1991.

Field Performance and Evaluation of Thin Bonded Overlays, by D. Peshkin and A. Mueller, Transportation Research Record 1286, Transportation Research Board, 1990.

Considerations in the Design of Jointed Concrete Pavements, by K. Smith, D. Peshkin, and M. Darter, 6th International Symposium on Concrete Roads, Madrid, Spain,1990.

Field Determination of the Asphalt Content of Asphalt Concrete, by D. Peshkin and S. Carpenter, Proceedings, Workshop on the State of the Art in Field Control of Asphalt Concrete Mixes, Portland, Oregon, 1990.

Performance Evaluation of Experimental Pavement Designs at Clare, Michigan, by D. Peshkin,

K. Smith, M. Darter, and C. Arnold, Transportation Research Record 1227, Transportation Research Board, 1989.

An Eleven Year Evaluation of Arizona's Prestressed Pavement, by D. Peshkin, A. Mueller, K. Smith, and M. Darter, Proceedings, 4th International Conference on Concrete Pavement Design and Performance, Purdue University, Indiana, 1989.

Effect of Design Features on Concrete Pavement Performance, by K. Smith, D. Peshkin, M. Darter, and A. Mueller, Proceedings, 4th International Conference on Concrete Pavement Design and Performance, Purdue University, Indiana,1989.

Evaluation of Concrete Pavement Performance and Design Features, by K. Smith, D. Peshkin, M. Darter, A. Mueller, and S. Carpenter, Report No. FHWA-RD-89-136, 1989.

Performance Evaluation and Analysis of Thin Bonded Concrete Overlays, by D. Peshkin, A. Mueller, K. Smith, and M. Darter, Report No. FHWA-RD-89-144, 1989.

Evaluation and Modification of Concrete Pavement Design and Analysis Models, by A. Mueller, D. Peshkin, K. Smith, and M. Darter, Report No. FHWA-RD-89-137, 1989.

Summary of Analysis Data for the Evaluation of Predictive Models, by A. Mueller, D. Peshkin, K. Smith, and M. Darter, Report No. FHWA-RD-89-141, 1989.

General Policy for Airfield Pavement Design, by R. Roman, M. Darter, D. Peshkin, S. Carpenter, and S. Stoffels, U.S. Navy MIL-HDBK-1021/2, 1988.

SELECTED PRESENTATIONS

Introduction to Pavement Preservation, presented at the National Pavement Preservation Forum, California, November 8-9, 2001.

HDM-4: The Road Deterioration and Maintenance Effects Study, presented at the 2nd International Conference on Pavement Technology, Singapore, September 27-29, 1995.

Crack Sealing and Pothole Repair, an invited presentation at the 1994 Annual Meeting of the Minnesota American Public Works Association, October 1994.

Revisions to the AASHTO Guide for Design of Pavement Structures, and *DARWin—AASHTO's Pavement Design Software*, an invited presentation at the 4th Annual Southeastern States Pavement Management and Design Workshop, Gulf Shores, Alabama, June 21-24, 1993.

The Construction and Performance of Concrete Pavements Reinforced with Flexarm, presented at the Showcase of Innovative Construction Methods and Technologies for Roads and Bridges, Kansas City, Missouri, June 10-12, 1992.

Flexarm—CRCP Reinforcement, presented at the Northwest Concrete Pavement Seminar, Portland, Oregon, and October 15-16, 1992.

AASHTO's Pavement Design Software and Pavement Overlay Design Methodology, presented at the 6th Annual 4R Conference, Atlanta, Georgia, December 6-8, 1992.

Early Opening of New PCC Pavement and PCC Repairs to Traffic, 5th International Pavement Management/Maintenance Exposition & Conference, Cincinnati, Ohio, 1991.

Effect of Design Features on Concrete Pavement Performance, presented at the 10th Annual Missouri/Kansas Concrete Paving Workshop, Kansas City, Missouri, 1990.

An Introduction to AASHTO's Pavement Design Software, presented at the 32nd Annual International Meeting of Highway Engineering Exchange Program, Rapid City, South Dakota, 1990.

Field Determination of the Asphalt Content of Asphalt Concrete, presented at the Workshop on the State of the Art in Field Control of AC Mixes, Portland, Oregon, 1990.

Pavement Design and Evaluation with the 1986 AASHTO Design Model, presented at the 8th Annual FHWA Region 1 Pavement Management Conference, Newport Beach, Rhode Island, 1989.

APPENDIX B
Letters of Agreement

MeadWestvaco Corporation
P.O. Box 118005
Charleston, SC 29423 8005

Specialty Chemicals Division
tel 843 740 2300

MeadWestvaco

November 11, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding Slurry Seal and Micro-Surfacing Mix Design Procedure. We would be pleased to participate with you on this subject by serving on an advisory group.

We look forward to working with you in this effort and sincerely hope that you are awarded the project.

Sincerely,

Robert E. Jerman, Jr.

Robert E. Jerman, Jr.
Technical Service Manager, Asphalt
Polychemicals Department

REJ:tta

11/08/2002 17:54 FAX 702 844 0128 American Asphalt 001

3524 Goldfield St. • No. Las Vegas, NV 89032-3208 • (702) 649-2669 • FAX (702) 649-8693

November 8, 2002

Mr. Glynn Holleran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: **Caltrans Request for Proposal #65A0151**
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you by serving on the advisory group for this project.
We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

Eric M. Reimschiissel

KOCH MATERIALS ID:9138237024 NOV 08'02 13:49 No.002 P.02

KOCH
Pavement Solutions
...Longer Lasting Roads

October 18, 2002

Mr. Glynn Holleran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: **Caltrans Request for Proposal #65A0151**
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you by serving on the advisory group for this project.
We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

P.O. Box 440 • Salina, Kansas 67402-0440 • 785.823.7645 • Fax 785.823.7024

Fax émis par : 33 01 47 61 74 81 DGIO 08/11/02 14:17 Pg: 1/1

COLAS

Boulogne, 8th of November 2002

COLAS S.A. FAX

To :	Mr. Glynn Holleran	*From :*	Mr François CHAIGNON
Company :		*Company :*	COLAS S.A.
Fax :	00 1 707 449 3815	*Fax :*	33 1 47 61 74 81
Copy to:		*Our Ref. :*	DGIO - FC/CC
Number of Pages (including front page) [1]			

SUBJECT :	**Caltrans Request for Proposal #65A0151** Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you by serving on the advisory group for this project.
We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

François CHAIGNON
Technical and Development Director
Direction Internationale Ouest
COLAS SA
chaignon@siege.colas.fr

[1] *If you do not receive all the pages, please contact us as soon as possible*

11/08/2002 04:28 FAX 003

STRAWSER
INCORPORATED

October 24, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: Caltrans Request for Proposal #65A0151
Slurry/Micro-Surfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you with the construction of a pilot project using the new slurry and micro-surfacing mix design procedure that you hope to develop in this endeavor by providing the services of Chris Anspaugh to serve on the Advisory Panel for this project. It is our understanding that any work required for these pilot projects will be paid for by agency funds.

We look forward to working with you on these projects and wish you the best of luck in acquiring this project.

Best regards,

Michael W. Buckingham
President

Pavement Maintenance Systems

Micro-Surfacing

Slurry Seal

Crack Treatments

Chip Seal

Asphalt Paving

Equal Opportunity Employer
1595 Frank Road Columbus, OH 43223 Tel 614/276-5501 Fax 614/276-0570

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AKZO NOBEL

Asphalt Applications

October 18, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

RE: Caltrans Request for Proposal #65A0151
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 10th regarding the above subject. I would be more than glad to assist you by serving on an advisory group for this project.

We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

Alan

Alan James
Research and Technology Manager – Asphalt Applications

Akzo Nobel Surface Chemistry LLC
7101 Adams Street, Unit 7
Willowbrook, Illinois 60527
Tel. (630) 789 2494
Fax (630) 789 2506
Toll Free (800) 248 8636

BASF Corporation

BASF

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October 18, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

RE: Caltrans Request for Proposal #65A0151
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 11, 2002 regarding the subject. I would be more than glad to assist you by serving on an advisory group for this project.

We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

Dr. Koichi Takamura
Senior Research Scientist
BASF Corporation

11501 Steele Creek Road, Charlotte, North Carolina 28273 Telephone (704) 588-5280 Fax (704) 587-8232

04/17/2003 08:34 PRS BINDERS LAB → 0001519163319384 NO.480 P02

Pioneer Road Services Pty Ltd

A.C.N. 000 538 858
NSW BRANCH OFFICE
Locked Bag 13, Windsor, NSW, 2756
25 Groves Avenue, McGrath's Hill, NSW
Telephone: 045 602 111
Facsimile: 045 602 149

October 21, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

RE: Caltrans Request for Proposal #65A0151
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn,

Thank you for your letter of October 10, 2002 regarding the above subject. I would be pleased to assist you by serving on an advisory group for this project.

I look forward to providing whatever assistance time allows on these projects and offer my congratulations on securing this research proposal.

Yours sincerely,

John Lysenko
Technical Manager, Road Binders & Surfacing
Pioneer Road Services Pty Ltd

JAN. 11. 1997 3:52AM NO. 0181 P. 2

P.O. Box 23028
Jackson, MS
39225-3028

601-933-3000

Ergon
Asphalt & Emulsions

October 18, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: **Caltrans Request for Proposal #65A0151**
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you by serving on the advisory team. We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Very truly yours,

Mark Ishee
Technical Marketing Manager
Ergon Asphalt & Emulsions, Inc.

KOCH
Pavement Solutions
...Longer Lasting Roads

October 30, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road – Suite 108
North Highlands, CA 95660

Subject: Caltran's Request for Proposal #65A0151
Slurry/Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you with the construction of a pilot project using the new slurry and microsurfacing mix design procedure that you hope to develop in this endeavor by providing the services of Susan Stauffer and/or Arlis Kadrmas to serve on the advisory group for this project. It is our understanding that any work required for these pilot projects will be paid for by agency funds.

We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Sincerely,

Bradley J. Schmitz

Bradley J. Schmitz
Koch Pavement Solutions

4027 East 37th Street North • Wichita, KS 67220 • P.O. Box 1875 • Wichita, KS 67201 • 316.828.5500

E.J. BRENEMAN, L.P.
PAVEMENT RECONSTRUCTION & PRESERVATION

60th ANNIVERSARY E.J. BRENEMAN 1942 2002

October 30, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, Ca. 95660

Re: Caltrans Request for Proposal # 65A0151
Slurry / Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more that happy to assist you with the construction of a pilot project using the new slurry and microsurfacing mix design procedure that you hope to develop in this endeavor. It is our understanding that any work required for these pilot projects will be paid for by agency funds.

We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Sincerely,

John M. DeMartino
General Partner

(610) 678-1913 • FAX (610) 678-9691
1117 SNYDER ROAD, WEST LAWN, PA 19609-1100
MILLER MUNICIPAL SUPPLY (610) 678-8207
sales@ejbreneman.com

Micro-Surfacing, Inc.

Micro-Surfacing, Inc.
13745 Rear Lackland Rd.
St. Louis, MO 63146
(314) 989.9001

Peoria Office
P.O. Box 116
Peoria, IL 61650
(309) 694.3686

October 28, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

RE: Caltrans Request for Proposal #65A0151
Slurry/Micro-Surfacing Mix Design Procedure

Dear Glynn:

Thank-you for your letter of October 18, 2002 regarding RFP # 65A0151. We would be more than happy to assist you with the construction of a pilot project using the new slurry and micro-surfacing mix design procedure that you hope to develop in this endeavor. It is our understanding that any work required for these pilot projects will be paid for by agency funds.

We look forward to working with you on these projects and wish you the best of luck in acquiring the project.

Sincerely,

Tom Ritschel/Pres.

MICRO-SURFACING

BALLOU CONSTRUCTION CO., INC.

STREET AND ROAD SURFACING

Telephone (785) 825-5303 • FAX (785) 825-7036 • Post Office Box 2300 • Salina, Kansas 67402-2300

October 28, 2002

Glynn Holleran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, California 95660

Re: Caltrans Request for Proposal #65A0151
Slurry Seal/Micro-Surfacing Mix Design Procedure

Glynn,

Thank you for your letter of October 18, 2002 concerning the Caltrans, Slurry Seal/Micro-Surfacing mix design study. This is a project that we at Ballou Const. hold high on our list of projects we would like to see accomplished. We have monitored this proposal for over five years now, and feel that it is a project that has great value for us and for our customers in many areas.

Ballou Const. would be please to assist the project with construction of pilot projects, using the new design procedures that are to be developed from the study.

It is our understanding that the projects will be funded by individual state funds and accomplished as other projects are currently done, with the exception of a new design procedure.

We would like to wish you well in acquiring the project and proceeding towards developing a new and universally accepted mix design procedure for the products.

Wishing you well,

Larry J. Day
Ballou Const. Co.

ASPHALT & GRADING CO.
3624 Goldfield St. • No. Las Vegas, NV 89032-3208 • (702) 649-2669 • FAX (702) 649-8693

October 30, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: Caltrans Request for Proposal # 65A0151
Slurry Seal / Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP # 65A0151. I would be more than happy to assist you with the construction of a pilot project using the new slurry seal and Microsurfacing mix design procedure that you hope to develop in this endeavor. It is our understanding that any work or items required for these projects will be paid for by agency funds.

I look forward to working with you on these projects and wish you the best of luck in acquiring the project. I will be happy to help by e-mail, conference calls, or other correspondence as needed.

Sincerely,

Eric M. Reimschiissel

VSS Valley Slurry Seal Co.

October 30, 2002

Mr. Glynn Holleran
MACTEC
4704 Roseville Road; Suite 108
North Highlands, CA 95660

Subject: Caltrans Request for Proposal # 65A0151
Slurry Seal / Microsurfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP # 65A0151. We would be more than happy to assist you with the construction of a pilot project using the new slurry seal and Microsurfacing mix design procedure that you hope to develop in this endeavor. It is our understanding that any work or items required for these projects will be paid for by agency funds

We look forward to working with you on these projects and wish you the best of luck in acquiring the project. We will be happy to help by e-mail, conference calls, or other correspondence as needed.

Sincerely,

Jeffrey Reed
President

P. O. BOX 1620 • WEST SACRAMENTO, CA 95691 • PHONE (916) 373-1500
FAX NO. (916) 373-1438 • CONTRACTOR'S LICENSE NO. 283727A

PAVEMENT MAINTENANCE SPECIALISTS

11/08/2002 04:28 FAX 02

STRAWSER
INCORPORATED

Pavement Maintenance Systems

Micro-Surfacing

Slurry Seal

Crack Treatments

Chip Seal

Asphalt Paving

October 24, 2002

Mr. Glynn Holeran
MACTEC
4704 Roseville Road, Suite 108
North Highlands, CA 95660

Subject: Caltrans Request for Proposal #65A0151
Slurry/Micro-Surfacing Mix Design Procedure

Dear Glynn:

Thank you for your letter of October 18, 2002 regarding RFP #65A0151. We would be more than happy to assist you with the construction of a pilot project using the new slurry and micro-surfacing mix design procedure that you hope to develop in this endeavor. It is our understanding that any work required for these pilot projects will be paid for by agency funds.

We look forward to working with you on these projects and wish you the best of luck in acquiring this project.

Best regards,

Michael W. Buckingham
President

APPENDIX C
Caltrans Forms

ATTACHMENT 1

ATTACHMENT CHECK LIST

A complete Proposal package will consist of the items identified below. Complete this checklist to confirm the items in your Proposal. Place a check mark or "X" next to each item that you are submitting to the State. All attachments identified below are applicable to this RFP and must be returned, as instructed, for your Proposal to be responsive. **Return this checklist with your Technical Proposal package.**

Technical Proposal and Attachments
NOTE: Return this Checklist with the Technical Prosposal package.

Attachments	Attachment Name/Description
_____ Technical Proposal	Technical Proposal as stated in this RFP
_____ Attachment 1	Proposal Attachment Check List
_____ Attachment 2	Contractor Certification Clauses (CCC 702). The CCC 702 can also be found on the Internet at http://www.dgs.ca.gov/contracts. Page one (1) must be signed and submitted prior to the award of the Agreement.

Cost Proposal and Attachments
NOTE: All Cost Proposal Information and applicable Attachments MUST be packaged separately from the Technical Prosposal package. **No Cost Information of any kind is allowed in the Technical Proposal.**

Attachments	Attachment Name/Description
_____ Attachment 3	Proposal/Proposer Certification Sheet
_____ Attachment 4	Cost Proposal Worksheet
_____ Attachment 7	Disadvantaged Business Enterprise (DBE) Participation Forms: **ADM 0227F Bidder/Proposer DBE Information, and ADM 0312F Bidder/Proposer DBE Good Faith Effort Information,** and all necessary attachments.
_____ Attachment 8	Target Area Contract Preference Act (TACPA)
_____ Attachment 9	Enterprise Zone Act (EZA)
_____ Attachment 10	Local Agency Military Base Recovery Area (LAMBRA) Act

ATTACHMENT 2
CONTRACTOR CERTIFICATION CLAUSES

CCC702

CERTIFICATION

I, the official named below, CERTIFY UNDER PENALTY OF PERJURY that I am duly authorized to legally bind the prospective Contractor to the clause(s) listed below. This certification is made under the laws of the State of California.

Contractor/Bidder Firm Name (Printed)	*Federal ID Number*
By (Authorized Signature)	
Printed Name and Title of Person Signing	
Date Executed	*Executed in the County of*

CONTRACTOR CERTIFICATION CLAUSES

1. STATEMENT OF COMPLIANCE: Contractor has, unless exempted, complied with the nondiscrimination program requirements. (GC 12990 (a-f) and CCR, Title 2, Section 8103) (Not applicable to public entities.)

2. DRUG-FREE WORKPLACE REQUIREMENTS: Contractor will comply with the requirements of the Drug-Free Workplace Act of 1990 and will provide a drug-free workplace by taking the following actions:

a. Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession or use of a controlled substance is prohibited and specifying actions to be taken against employees for violations.

b. Establish a Drug-Free Awareness Program to inform employees about:

1) the dangers of drug abuse in the workplace;
2) the person's or organization's policy of maintaining a drug-free workplace;
3) any available counseling, rehabilitation and employee assistance programs; and,
4) penalties that may be imposed upon employees for drug abuse violations.

c. Every employee who works on the proposed Agreement will:

1) receive a copy of the company's drug-free workplace policy statement; and,

2) agree to abide by the terms of the company's statement as a condition of employment on the Agreement.

Failure to comply with these requirements may result in suspension of payments under the Agreement or termination of the Agreement or both and Contractor may be ineligible for award of any future State agreements if the department determines that any of the following has occurred: (1) the Contractor has made false certification, or violated the certification by failing to carry out the requirements as noted above. (GC 8350 et seq.)

3 NATIONAL LABOR RELATIONS BOARD CERTIFICATION: Contractor certifies that no more than one (1) final unappealable finding of contempt of court by a Federal court has been issued against Contractor within the immediately preceding two-year period because of Contractor's failure to comply with an order of a Federal court which orders Contractor to comply with an order of the National Labor Relations Board. (PCC 10296) (Not applicable to public entities.)

4. UNION ORGANIZING Contractor hereby certifies that no request for reimbursement, or payment under this agreement, will seek reimbursement for costs incurred to assist, promote or deter union organizing.

DOING BUSINESS WITH THE STATE OF CALIFORNIA

The following laws apply to persons or entities doing business with the State of California.

1. CONFLICT OF INTEREST: Contractor needs to be aware of the following provisions regarding current or former state employees. If Contractor has any questions on the status of any person rendering services or involved with the Agreement, the awarding agency must be contacted immediately for clarification.

Current State Employees (PCC 10410):

1) No officer or employee shall engage in any employment, activity or enterprise from which the officer or employee receives compensation or has a financial interest and which is sponsored or funded by any state agency, unless the employment, activity or enterprise is required as a condition of regular state employment.

2) No officer or employee shall contract on his or her own behalf as an independent contractor with any state agency to provide goods or services.

Former State Employees (PCC 10411):

1) For the two-year period from the date he or she left state employment, no former state officer or employee may enter into a contract in which he or she engaged in any of the negotiations, transactions, planning, arrangements or any part of the decision-making process relevant to the contract while employed in any capacity by any state agency.

2) For the twelve-month period from the date he or she left state employment, no former state officer or employee may enter into a contract with any state agency if he or she was employed by that state agency in a policy-making position in the same general subject area as the proposed contract within the 12-month period prior to his or her leaving state service.

If Contractor violates any provisions of above paragraphs, such action by Contractor shall render this Agreement void. (PCC 10420)

Members of boards and commissions are exempt from this section if they do not receive payment other than payment of each meeting of the board or commission, payment for preparatory time and payment for per diem. (PCC 10430 (e))

2. LABOR CODE/WORKERS' COMPENSATION: Contractor needs to be aware of the provisions which require every employer to be insured against liability for Worker's Compensation or to undertake self-insurance in accordance with the provisions, and Contractor affirms to comply with such provisions before commencing the performance of the work of this Agreement. (Labor Code Section 3700)

3. AMERICANS WITH DISABILITIES ACT: Contractor assures the State that it complies with the Americans with Disabilities Act (ADA) of 1990, which prohibits discrimination on the basis of disability, as well as all applicable regulations and guidelines issued pursuant to the ADA. (42 U.S.C. 12101 et seq.)

4. CONTRACTOR NAME CHANGE: An amendment is required to change the Contractor's name as listed on this Agreement. Upon receipt of legal documentation of the name change the State will process the amendment. Payment of invoices presented with a new name cannot be paid prior to approval of said amendment.

5. CORPORATE QUALIFICATIONS TO DO BUSINESS IN CALIFORNIA:

a. When agreements are to be performed in the state by corporations, the contracting agencies will be verifying that the contractor is currently qualified to do business in California in order to ensure that all obligations due to the state are fulfilled.

b. "Doing business" is defined in R&TC Section 23101 as actively engaging in any transaction for the purpose of financial or pecuniary gain or profit. Although there are some statutory exceptions to taxation, rarely will a corporate contractor performing within the state not be subject to the franchise tax.

c. Both domestic and foreign corporations (those incorporated outside of California) must be in good standing in order to be qualified to do business in California. Agencies will determine whether a corporation is in good standing by calling the Office of the Secretary of State.

6. RESOLUTION: A county, city, district, or other local public body must provide the State with a copy of a resolution, order, motion, or ordinance of the local governing body which by law has authority to enter into an agreement, authorizing execution of the agreement.

7. AIR OR WATER POLLUTION VIOLATION: Under the State laws, the Contractor shall not be: (1) in violation of any order or resolution not subject to review promulgated by the State Air Resources Board or an air pollution control district; (2) subject to cease and desist order not subject to review issued pursuant to Section 13301 of the Water Code for violation of waste discharge requirements or discharge prohibitions; or (3) finally determined to be in violation of provisions of federal law relating to air or water pollution.

8. PAYEE DATA RECORD FORM STD. 204: This form must be completed by all contractors that are not another state agency or other government entity.

STATE OF CALIFORNIA--BUSINESS, TRANSPORTATION AND HOUSING AGENCY GRAY DAVIS, Governor

DEPARTMENT OF TRANSPORTATION
ADMINISTRATION
DIVISION OF PROCUREMENT AND CONTRACTS MS-67
1727 30th STREET
SACRAMENTO, CA 95816-7006
PHONE (916) 227-6000
FAX (916) 227-6155
INTERNET http://caltrans-opac.ca.gov

Flex your power!
Be energy efficient

October 8, 2002

Addendum One to
Request for Proposal No. 65A0151
'Slurry/Micro-Surface Mix Design Procedure'

The Department is asking all potential project managers to consider signing the attached document and returning with your bid submission.

All other terms and conditions of the original bid document remain unchanged. If you have any questions, please call me at (916) 227-6005.

Sincerely,

Dennis Siebert
Service Contract Analyst

Confidentiality Agreement

We, proposers, understand that contract 65A0151 entitled "Slurry/Micro-Surface Mix Design Procedure" is a pooled-fund study that includes 12 other states (Delaware, Georgia, Illinois, Kansas, Michigan, Minnesota, Missouri, North Dakota, New Hampshire, New York, Texas and Vermont). We agree that our proposal(s) may be confidentially shared with technical representatives of these states and the Federal Highway Administration (FHWA). Representatives of Caltrans will be solely responsible for the selection of the contractor.

Project Manager Signature

Print Name

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY GRAY DAVIS, Governor

DEPARTMENT OF TRANSPORTATION
ADMINISTRATION
DIVISION OF PROCUREMENT AND CONTRACTS MS-67
1727 30th STREET
SACRAMENTO, CA 95816-7006
PHONE (916) 227-6000
FAX (916) 227-6155
INTERNET http://caltrans-opac.ca.gov

Flex your power!
Be energy efficient

October 31, 2002

Addendum Two to
Request for Proposal No. 65A0151
'Slurry/Micro-Surface Mix Design Procedure'

Please see the attached revision of Attachments 5 and 6 of the above RFP--these replace the original Attachments 5 and 6.

Also, please note the following revisions to Section C) Paragraph 1 – Time Schedule:

EVENT	DATE	TIME
Oral Interviews	Week of 1/6/03	
Cost Proposal Opening	1/16/03	2:30 PM
Posting of Notice of Intent to Award	1/17/03	11:00 AM
Last Day to Protest the Award	1/24/03	5:00 PM
BEP/Risk Assessment/Pre-Award Audit Findings	1/24/03	5:00 PM
Agreement Award	1/24/03	11:00 AM

All other terms and conditions of the original bid document remain unchanged. If you have any questions, please call me at (916) 227-6005.

Sincerely,

Dennis Siebert
Service Contract Analyst

ATTACHMENT 5

CRITERIA FOR EVALUATION OF CONSULTANT TECHNICAL PROPOSALS

Technical Proposal Evaluation:	Maximum Possible Score (Weighted Score)	Consensus Determination - %	Score
I. CLARITY AND ORGANIZATION OF PROPOSAL RESPONSE			
A. Clarity of Proposal	5		
B. Organization of Proposal	5		
C. Conciseness of Proposal	5		
NARRATIVE			
II. CONTRACTOR'S UNDERSTANDING OF DEPARTMENT'S REQUEST			
A. Project Scope	10		
B. Department's Problems and Requirements	10		
C. Project Requirements	10		
NARRATIVE			
III. CONTRACTOR'S APPROACH TO TECHNICAL WORK			
A. Design Methodology	20		
B. Design Techniques for Achieving Flexibility	15		
C. Statement of Technical Requirements	20		
D. Meets Project Requirements	15		
E. Project Scope	15		
NARRATIVE			
IV. CONTRACTOR'S APPROACH TO PROJECT MANAGEMENT			
A. Project Work Plan and Schedule	10		
NARRATIVE			
V. CONTRACTOR QUALIFICATIONS AND EXPERIENCE			
A. Internal Organization and Size	15		
B. References	15		
NARRATIVE			
VI. STAFF QUALIFICATIONS AND EXPERIENCE			
A. Consulting Team Organization	15		
B. Resumes	15		
NARRATIVE			
TOTAL POSSIBLE			200
TOTAL ACTUAL			
TOTAL PERCENT			

ATTACHMENT 6

CRITERIA FOR EVALUATION OF CONSULTANT ORAL PRESENTATIONS

Oral Presentation Evaluation:	Maximum Possible Score (Weighted Score)	Consensus Determination - %	Score
I. CONTRACTOR'S APPROACH TO TECHNICAL WORK			
	40		
II. CONTRACTOR'S APPROACH TO PROJECT MANAGEMENT			
	20		
III. CONTRACTOR QUALIFICATIONS AND EXPERIENCE			
	40		
TOTAL POSSIBLE			100
TOTAL ACTUAL			
TOTAL PERCENT			